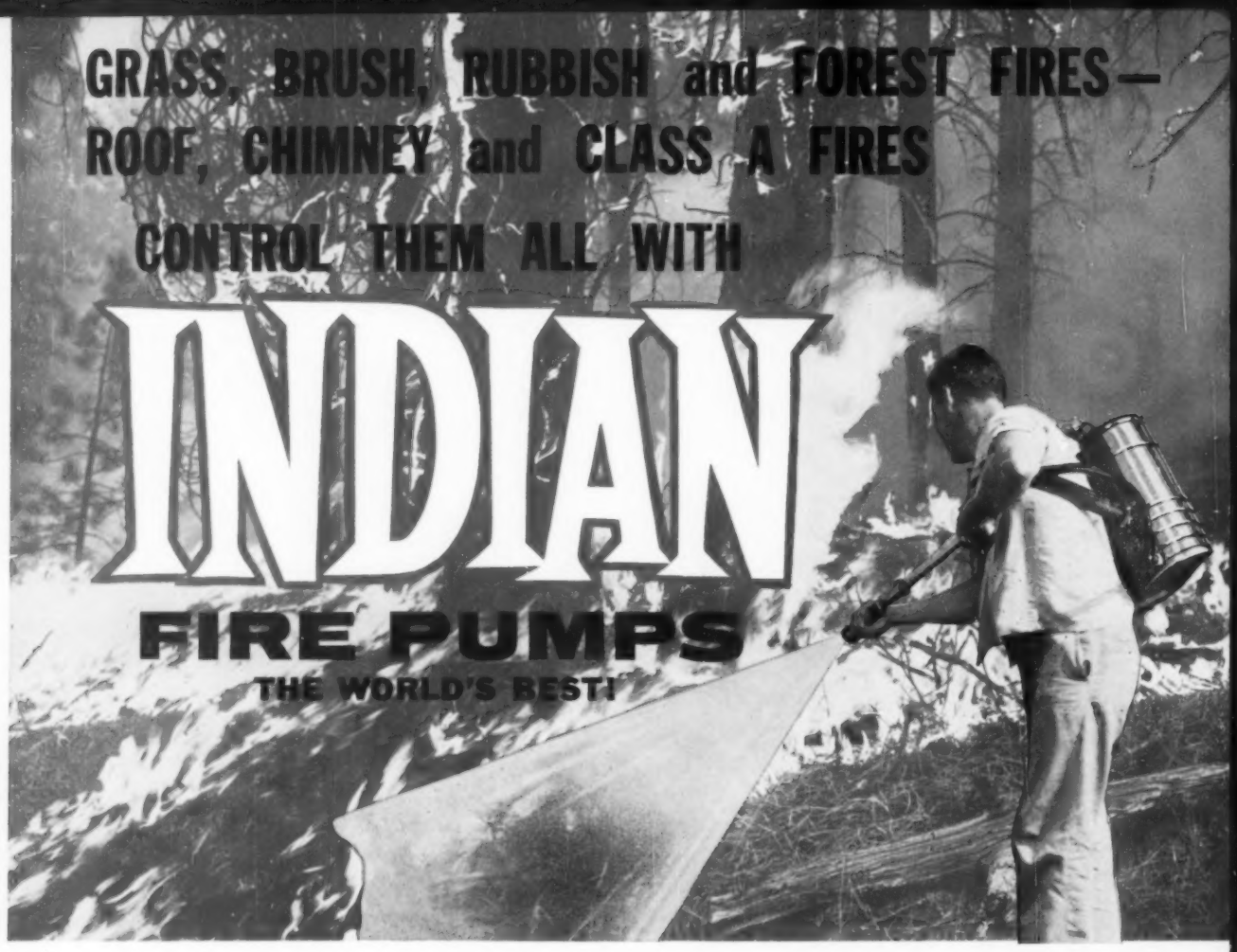
SOCIETY OF AMERICAN FORESTERS 1900

Journal of FORESTRY

March 1961
Volume 59
Number 3

GRASS, BRUSH, RUBBISH and FOREST FIRES—
ROOF, CHIMNEY and CLASS A FIRES
CONTROL THEM ALL WITH

INDIAN
FIRE PUMPS
THE WORLD'S BEST!



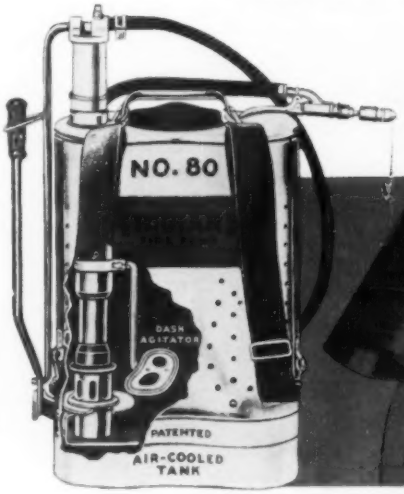
For over 30 years INDIANS have been putting out small fires before they grow into big ones. Today's models have been improved and it is a pleasure to operate them. Fire fighters call the INDIAN "a one man fire department" and tell us "they are worth their weight in gold."

No. 90 INDIAN FIRE PUMP
(Sliding Pump Type)

Send for circular on our new **No. 90 FIBER-GLASS** tank model. Light weight. Will not rust or corrode. Brass pump.

All models of INDIAN FIRE PUMPS are approved by Factory Mutual.

No. 90 sliding pump type shown above. Available in Armco zinc grip steel, solid brass or Chrome tanks.



No. 80 INDIAN
(lever type pump and handle)

Continuous high pressure. Pump throws strong stream or nozzle adjusts for spray or fog mist. Sturdily built to give many years of service.

D. B. SMITH & CO. "FOR SEVENTY-THREE YEARS THE LEADERS"

407 Main St., Utica 2, N.Y.

Pacific Coast Branches:

Hercules Equipment & Rubber Co., Inc. San Francisco 7, Calif. San Jose, Calif.

Halprin Supply Co. Los Angeles 15, Calif.

Fred E. Barnett Co. Portland, Ore.

Fred E. Barnett Co. Klamath, Ore.

Mill & Mine Supply Inc. Seattle 4, Wash.

L. M. Curtis & Sons Salt Lake City, Utah

Canadian Agents:
Fleck Bros. Ltd. Vancouver, B. C., Canada
C. E. Hickey & Sons, Ltd. Hamilton, Canada

VOLUME 59
NUMBER 3

Journal of Forestry

MARCH 1961

EDITORIAL STAFF

ARTHUR B. MEYER ..... *Editor*
HENRY CLEPPER ..... *Managing Editor*
L. AUDREY WARREN ..... *Business Manager*

Associate Editors

JAMES S. BETHEL, *Forest and Wood Utilization*, National Science Foundation, Washington 25, D. C.

C. ALLEN BICKFORD, *Mensuration*, Northeastern Forest Experiment Station 102 Motors Avenue, Upper Darby, Pa.

ROBERT L. FURNISS, *Forest Pathology and Entomology*, Pacific Northwest Forest and Range Experiment Station, P. O. Box 4059, Portland, Ore.

OTIS F. HALL, *Forest Management and Engineering*, Department of Forestry and Conservation, Purdue University, Lafayette, Ind.

LEE M. JAMES, *Forest Economics and Policy*, Department of Forestry, Michigan State University, East Lansing, Mich.

ROBERT D. MCCULLEY, *Silviculture*, Lake States Forest Experiment Station, 300 Green Hall, St. Paul Campus, University of Minnesota, St. Paul 1, Minn.

LANSING A. PARKER, *Forest-Wildlife Management and Recreation*, Bureau of Sport Fisheries and Wildlife, U. S. Department of the Interior, Washington 25, D. C.

SCOTT S. PAULEY, *Forest Genetics and Artificial Regeneration*, School of Forestry, University of Minnesota, St. Paul 1, Minn.

CHARLES E. POULTON, *Range Management*, Range Management W-302, Oregon State College, Corvallis, Ore.

WILLIAM E. REIFSNYDER, *Forest Fire*, School of Forestry, Yale University, New Haven 11, Conn.

SIDNEY WEITZMAN, *Watershed Management*, Lake States Forest Experiment Station, 300 Green Hall, St. Paul Campus, University of Minnesota, St. Paul 1, Minn.

LLOYD THORPE, *Advertising Representative*, 766 Dexter Horton Building, Seattle 4, Wash.

The JOURNAL OF FORESTRY, established in 1917, is the official organ of the Society of American Foresters, but the Society assumes no responsibility for the statements and opinions expressed by contributors.

Publication office, 425 Mills Building, 17th Street at Pennsylvania Avenue N. W., Washington 6, D. C. Address all correspondence concerning editorial or business matters to JOURNAL OF FORESTRY, 425 Mills Building, 17th Street at Pennsylvania Avenue N. W., Washington 6, D. C. Published monthly. Subscription $9.00 per year; single copies $1.00. Missing numbers will be replaced without charge provided claim is made within thirty days after date of the following issue.

The editors are not responsible for loss or damage of manuscripts and photographs while in transit or in their possession. All material submitted for publication should be accompanied by return postage.

Copyright, 1961, by the Society of American Foresters. Second class postage paid at Washington, D. C. and at additional mailing offices.

CONTENTS

COVER: Canoeist end portage at Brent Lake, Quetico Provincial Park, Canada. (See page 167.)
Photo U. S. Forest Service by Leland J. Prater

Changing Wilderness Images and Forestry Policy ... Gordon L. Bultena and Marvin J. Taves 167

Reclamation of Timberlands Damaged by Oilfield Waste James W. Curlin and Robert W. McDermid 171

Water Use by Brush, Grass, and Grass-Forb Vegetation P. B. Rowe and L. F. Reimann 175

Changes in Form Class in a Red Pine Plantation Allen F. Horn 181

Development of Planted Loblolly Pine in a Poisoned Upland Hardwood Stand of the Lower Piedmont ... William D. Miller 184

Loblolly Pine Seed Production in the Virginia—North Carolina Coastal Plain ... Peter H. Allen and Kenneth B. Trousdell 187

A Simplified Method of Computing Cordwood Volumes in the Woods ... Jim E. Dale 191

Western Gall Rust Cankers in Lodgepole Pine Roger S. Peterson 194

White Pine Seed Consumption by Small Mammals Herschel G. Abbott 197

Tree Percent on Burned and Unburned Longleaf Seedbeds Lloyd F. Smith 201

Stretching the Pollen Supply R. Z. Callaham and J. W. Duffield 204

Notes and Observations ... 208

Progress With Direct Bark Inoculation for White Pine Blister Rust; Toxic Effects of a Fire Fighting Chemical; A Technique for Germinating Pollen of Sugar Maple; The Effect of Gibberellin on the Germination Rate of Eastern White Pine; University of Arizona Watershed Management Department; Slope or Flat Pruning of Pines—An Important Consideration in Christmas Tree Plantation Management.

Points of View ... 215

An Example of Group Action for Multiple Use; Further Notes on the Color Description of Foliage; Grazing and Multiple Use.

Book Reviews ... 218

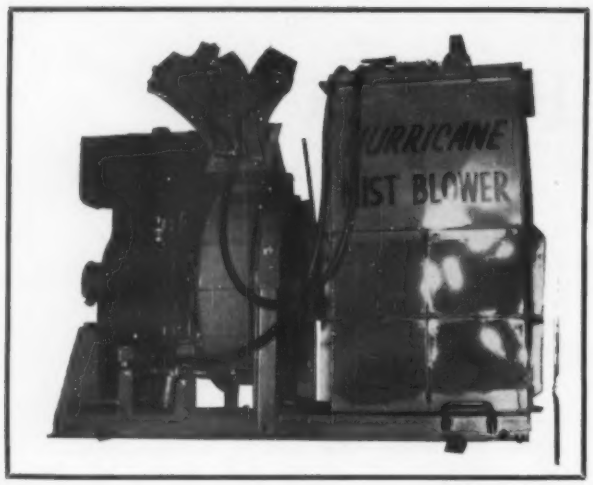
Biology and Control of the Western Pine Beetle: A Summary of the First Fifty Years of Research; The Development of Site Concepts at the Harvard Forest and Their Impact upon Management Policy; Photogrammetry and Photo-Interpretation (2nd edition of Aerial Photographs in Forestry); Land, Wood and Water; The Nature and Properties of Soil.

Current Literature ... 222

Society Affairs ... 223

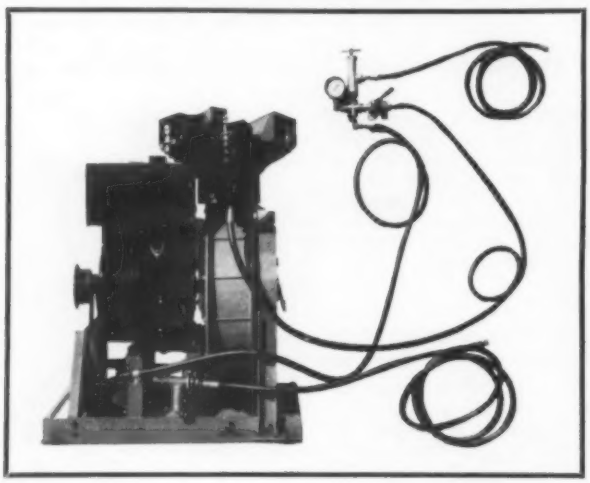
Forestry News ... 235

Index to Advertisers ... 244



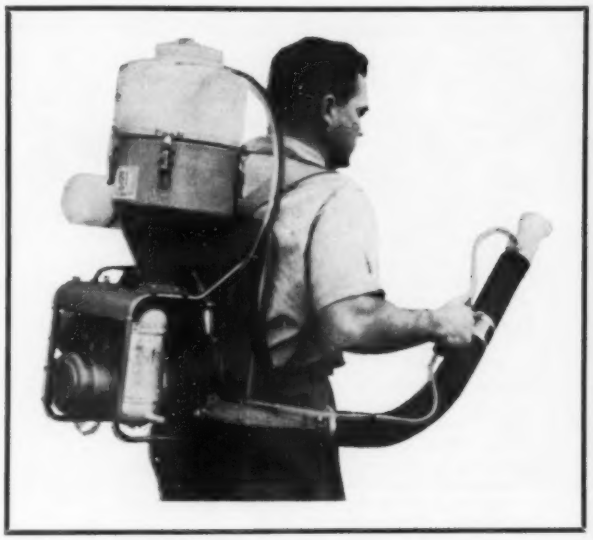
HURRICANE MODEL 32—The original heavy duty workhorse of the Hurricane family of mist blowers, Model 32 is designed for large-scale operations. Completely equipped, including a 32-gallon stainless steel tank, a 9 HP Briggs and Stratton gasoline engine and dynamically balanced blast wheel, it is easily mounted on tractor, jeep or truck. Thousands of acres of Hurricane-released conifers and Hurricane-prepared planting sites are testimony to its ability to do the job required of it. And the improved 1961 Model 32 is even more efficient. Price, $795.

HURRICANE BUDGET MODEL 32B—A fresh new concept offered for the first time by Forestry Suppliers, Inc. to give you more flexibility, greater ease of operation and lower cost. All of the good features of Model 32 are retained, except for the tank which the buyer provides—plus the added convenience of a control center placed in front of the vehicle operator. This newly designed feature makes it possible for the operator to keep pressure gauge under constant observation—and to quickly regulate flow of the solution. Compact and practical, Budget Model 32 is priced at only $666.



NOW. . . .

A Mist Blower for every need—and every budget



BAK-PAK MIST BLOWER—Here is Forestry Suppliers' new light weight fully portable mist blower, priced within reach of virtually any tree farmer. Equipped to discharge either concentrated liquids or normal density dust, it provides capabilities that open new techniques to foresters, nurserymen, and pest control experts. Equipped with a 2-cycle 3 HP engine, the Bak-Pak is easy to use, comfortable to carry. Completely equipped for both liquids and dusts, it is priced at only $254.

The bold new technique of controlling undesirable vegetation with herbicide mist has become firmly established in many sections of the country, thanks to equipment engineered by Forestry Suppliers, Inc.—the widely used Hurricane Mist Blower. Now, in response to demand, Forestry Suppliers is introducing a new development in this field—a mist blower for every need, and every budget. Your need—and your budget. Whatever your control problem, large or small, there is a Forestry Suppliers mist blower, heavy duty, budget or portable, to meet it.

Write today for full details

Telephone Fleetwood 4-3565

P. O. Box 8397, Battlefield Station, Jackson 4, Mississippi

FORESTRY SUPPLIERS
INCORPORATED

Journal of Forestry

Official Organ of the Society of American Foresters

Changing Wilderness Images and Forestry Policy

Gordon L. Bultena and
Marvin J. Taves

THIS article is concerned with the motives inducing vacationers to visit a forested recreation area, how they interpreted their visit, and the implications of this for forest policy and management. Data to be reported were obtained in two studies by sociologists (one conducted in 1956, the other in 1958) through 428 interviews with campground campers and canoeists[1] in the roadless area of the Quetico Provincial Park (Ontario, Canada) and the Superior National Forest (Minnesota). The studies were stimulated by a need for objective data on the characteristics and attitudes of vacationers who visit the Quetico-Superior in greater numbers each year. Many of the findings are relevant to the problems faced by administrators in other forested areas.

The development and management of recreational facilities are rapidly assuming a role equal in importance to other traditional concerns of the forester. In some forested areas regard for tourists is already consuming a major portion of supervisory time and finances. In light of the rapidly expanding recreational uses of the nation's forests, it is imperative that forest administrators concern themselves with social behavior as an integral aspect of forest management.

What motives prompt individuals to visit forested areas? What relevancy have these motives for the behavior of the vacationers while in the forests, and the attitudes they carry away from this experience? Professor S. T. Dana recognizes the importance of discerning attitudes toward the nation's forests as he states: ". . . the administrator is more apt to make a wise decision if he is fully informed as to public opinion; and if he is convinced that the public is wrong, he had better start an educational program to convert it to his way of thinking if he wishes his decision to stick."[2]

The Studies

Interviews conducted with 45 vacationers as they entered the Quetico-Superior in 1956 discerned five primary images of the area. In so far as the Quetico-Superior has been traditionally viewed as a wilderness, most responses were phrased in this perspective. The images may be properly interpreted as motives inducing a trip to the Forest.[3] They include:

1. *Wilderness as a locale for sport and play.*—The Quetico-Superior was seen as a locale in which one could engage in outdoor activities of a nature seldom pursued in the respondents' home communities. These individuals saw their more typical role of spectator being transformed, in and by the wilderness, into that of participant.

2. *Wilderness as fascination.*—The natural qualities of the wilderness were viewed as providing a "summons" to adventure, an opportunity to struggle with the elements. Respondents saw their trips as a form of exploration, an opportunity to gain new experiences and realizations seldom found in what they considered the less natural or "artificial" setting of the city.

3. *Wilderness as sanctuary.*—A vacation in the Quetico-Superior was seen as providing an opportunity to leave an impersonal city, the monotony of work, and an "other-directed" environment far behind, both mentally and physically. Intimate spontaneities of the camp group were seen as replacing dull routines and the conformity of daily life.

4. *Wilderness as heritage.*—A trip to the wilderness was seen by some respondents as providing an occasion to pass on much of the nation's frontier history to their offspring, and to personally relive

THE AUTHORS are, respectively, research associate in the Department of Sociology, and associate professor of sociology and supervisor of rural sociology, University of Minnesota.

[1]Lodge and resort vacationers are also represented in the Superior National Forest, but are not considered in this discussion as they comprise only a small proportion of all vacationers in the roadless or wilderness sector.

[2]Dana, S. T. Research in forest recreation. Forest Service, U. S. Dept. Agric. p. 7. 1957.

[3]The 1956 interviews were conducted as the vacationers first entered the roadless sector of the Quetico-Superior. Early contact with the respondents was desirable in that it was felt that exposure to the area might affect their initial image of it.

the glamorous experiences of early fur traders, pioneers, and explorers. A great part of the nation's past was felt to come alive in evening campfire stories.

5. *Wilderness as personal gratification.*—Some respondents felt that they first began to realize their full capabilities in a natural setting. A few denoted an emotional catharsis, with a psychological culmination revitalizing them for a return to the emotional pressures surrounding their everyday lives. For others, the experience apparently provided a status symbol, an opportunity to explain to friends how they had braved the wilderness, proving a manliness associated with facing unknown dangers typically assigned to wilderness areas.[4]

Not all of these images existed for all of the 1956 vacationers, and some reported more than others, yet almost all held their wilderness experience as potentially rewarding in at least one or more of these categories.

More extensive research undertaken in the Quetico-Superior in 1958, involving a sample in space and time, attempted to discern: (1) which of these images, or motives, was the more important or more frequently held, (2) whether different user groups held contrasting images of the area, and if this led to a differential evaluation of the Forest and its management, and (3) the implications of differential image perception among user groups, if any, for management policy.

An analysis of the images that 383 vacationers had of the Quetico-Superior prior to undertaking a canoe or camping trip in 1958, as revealed through their responses to an open-end question, shows the "wilderness as fascination" category to be the most prevalent; approximately 40 percent of all visitors entered the area in expectation of finding it primitive, isolated, natural, and having an undisturbed character.[5] Approximately one in seven viewed the area primarily in the perspective of its providing an opportunity for sport and play, as realized in such activities as boating and fishing. The image of the Forest as sanctuary, as heritage, and as leading to personal gratifications was each volunteered by fewer than five percent of the respondents. This is not to be regarded as indicating that these images were not important to a number of persons, but only that fewer respondents mentioned them as *most* salient. It appears that vacationers are much more perceptive of the concrete elements of the area, such as its lakes and opportunities for fishing, than they are of more abstract qualities such as its "medicinal character," and potentialities for escaping pressing cares and problems. However, when these more abstract qualities of a wilderness visit were suggested to the respondents, they rated many of them as important reasons for their visiting the area.

For many respondents a hierarchy of motives exists, with some reasons for vacationing in the area regarded as more important than others. This is illustrated by the cases of many fishermen who, even when returning to camp with empty creels, are not really disappointed with the area because they value their visit, not by the number of fish caught, but rather by the opportunity to enjoy an extensive area of natural forest and lake country.

In a further attempt to elucidate the vacationers' images of the Quetico-Superior, and consequently their motives for visiting it, respondents were asked to rate, from a personal perspective, the importance of various benefits which have been advanced at one time or another as accruing from camping participation. A total of 17 different benefits were rated.

Respondents could rate each potential benefit, as it related to them, as "not at all important," "not too important," "important," or "very important." No benefit was rated as "very important" by more than half the respondents, although one was chosen as "very important" by 47 percent of the canoeists and 49 percent of the campers (Table 1).

An important pattern of consistency is reflected in these ratings. Canoeists and campground campers, as different user groups, both rated the same six benefits as the most important and were in general accord about the position of the rest. Furthermore, there was an internal consistency in the ratings. The benefits which received the most "very important" ratings tended to receive the fewest "not at all important" choices.

When presented in this form, it is clear that many campers and canoeists think of their trips to the Quetico-Superior as a means of escaping familiar routines and the cares associated with living in an urbanized society. This consideration, abstract in form, is not as salient as the more concrete image vacationers maintain of the area, namely its wilderness fascination—as revealed in the unstructured solicitation[6] of response in both the 1956 and 1958 studies.

[6]The structured question differs from the unstructured in that the former allows the interviewee to answer a question by selecting his choice from among a series of answers suggested to him, while the latter forces him to formulate his own answer without such aid.

TABLE 1.—REASONS FOR CAMPING RATED AS "VERY IMPORTANT" BY CAMPERS AND CANOEISTS IN THE QUETICO-SUPERIOR

Reason	Percentage of campers rating "Very Important"	Percentage of canoeists rating "Very Important"
Provides an opportunity to leave all of the cares of the workaday world behind	49	47
Helps one to gain experience in doing things by one's self	30	34
Helps develop foresight and ability to plan	32	28
Helps one to get close to the Creator	31	28
Is something new and different	22	28
Provides physical "reconditioning"	23	25

[4]Stone, Gregory P., and Marvin J. Taves. "Camping in the wilderness" in Mass Leisure. Edited by Eric Larrabee and Rolf Meyersohn. The Free Press, Glencoe, Ill. pp. 296-300. 1958.

[5]Taves, Marvin J., William Hathaway, and Gordon Bultena. Canoe country vacationers. Miscellaneous Report No. 39. Agric. Expt. Sta., University of Minnesota. p. 12. 1960.

However, it is not inconsistent with such an image. Hence, the opportunity to leave one's cares behind is seen as entirely compatible with a visit to a wilderness setting; in fact, many of the respondents felt that such an escape could only be achieved in the wilderness.

A relatively high proportion of the respondents felt that as a result of a wilderness trip they learned to do things better on their own and developed the ability and the foresight to plan. Respondents also envisaged their trips as a means of closer "communication" with the Creator, as furnishing something "new and different," and as providing a physical reconditioning (Table 1).

The motives, both concrete and abstract, that vacationers have for visiting the Quetico-Superior, as reflected in their images of the area, focus in great part on its wilderness qualities and the personal benefits that such qualities entail. Their response patterns indicate that they are drawn to this area by its primitiveness, naturalness, and the opportunity that it offers for adventure. They seek, in a wilderness setting, to escape from the cares associated with the workaday world and an "other-directed" environment which frequently imposes restrictions on individual creativity. They want to learn to do things by themselves, to pit their capabilities against the mysterious, and to them possibly threatening, uncertainties of the wilderness. They seek a new and different experience, one they consider unavailable in other contexts. This, for the majority of the vacationers, is the appeal of the Quetico-Superior.

On the basis of this appeal, one might postulate that most visitors would favor maintaining the Quetico-Superior in a natural wilderness state, which theoretically means limiting improvements only to those necessary for the health and safety of vacationers. Actually, 99 percent of both the canoeists and campers strongly favor preserving the area in its natural state.

However, in addition to indicating a desire to see the Quetico-Superior remain in a natural state, a relatively high proportion of the campers, and a somewhat smaller, although sizable proportion of the canoeists, inconsistently also favored the development of more facilities in the area. For instance, 82 percent of the campers, but only 34 percent of the canoeists, would like to see more campsites and campgrounds provided. In addition, a relatively high percentage of campers and a smaller proportion of canoeists would like to see first-aid stations, garbage disposal places, toilets, picnic tables, and fireplaces available. Campers, in sizable numbers, also desired wells for drinking water, signs pointing the way to facilities, separate toilets for men and women, places to buy groceries and to rent motors and boats, public telephones, planned recreation, showers, washrooms, and electricity (Table 2).

Theoretically, the inconsistency of (1) preserving the area in its natural state and (2) providing the numerous facilities requested appears evident, yet for the majority of vacationers they are not envisaged as incompatible. Interviewers repeatedly encountered parties which were drawn to the area by its wildness, primitiveness, and general wilderness character. Yet, in describing possible changes or improvements which might be forthcoming, many proceeded to note the need for facilities which would increase their comforts while camping.

TABLE 2.—IMPORTANCE OF SELECTED TYPES OF FACILITIES TO CAMPERS AND CANOEISTS IN THE QUETICO-SUPERIOR

Facilities	Campers: Percent[1] rating "Important"	Canoeists: Percent[1] rating "Important"
Rated by both campers and canoeists		
More campsites or campgrounds	82	34
First-aid stations	52	43
Garbage-disposal places	79	33
Toilets	78	18
Picnic tables	60	21
Fireplaces	54	24
Docks	26	4
Public launch tows and portage trucks	10	15
Rated by campers only		
Wells for drinking water	72	---
Signs pointing way to facilities such as toilets	65	---
Separate toilets for men and women	54	---
Places to buy groceries	49	---
Places to rent boats and motors	42	---
Public telephones	21	---
Planned recreation	16	---
Showers and washrooms	15	---
Electricity	12	---
Laundry facilities	10	---
Child-care facilities	8	---
Library facilities	6	---

[1]Percentages add to greater than 100 percent as the categories are not mutually exclusive.

A Social-Psychological Explanation

It appears that several factors are operating to produce a discrepancy between motives drawing vacationers to the Quetico-Superior, namely its wilderness fascination, and the expressed desire for improvements that many would like to see provided after they arrive.

An analysis of response patterns indicates that for some vacationers there is no apparent conflict or inconsistency between their image of the Quetico-Superior as wilderness and their desire for conveniences or improvements. In their thinking, wilderness subsumes the existence of picnic tables, wells, toilets, washrooms, and the like. These individuals simply do not adopt the more traditional definition of wilderness, substituting instead an "urban frame of reference," being unable or unwilling to dichotomize wilderness and urban values. Some have become so sensitized to conveniences found at home that their perception of what is minimally essential to one's health and welfare is distorted. Hence, not only does the "wilderness compromiser" demand con-

veniences be provided by the management, but he brings them from home in the form of elaborate trailers and camping gear. No matter how refined his camping, such an individual can still justifiably, in light of this frame of reference, proudly describe to friends at home how he braved the wilderness.

Other vacationers come to a realization, as a result of actual camping activities, that the naturalness and primitiveness they envisaged before arriving in the Quetico-Superior is not, in fact, what they really want to exist. It must be remembered that a sizable proportion of the vacationers formulated their image of the Quetico-Superior prior to visiting the area and while in an urban setting.[7]

In many respects their initial image represents a temporary rejection of what is seen as the "artificialities" of the city. They envisage the Quetico-Superior as providing an opportunity to escape such artificiality, as permitting an occasion to "struggle with the elements" and to reduce life's complexities to that which is basic or essential. Hence, they eagerly seek the primitiveness of the Forest and the opportunity to pit their individual capabilities against possible challenges of the wild.

Upon actually entering the Quetico-Superior many of these individuals face a new realization, namely that primitiveness requires sacrifices on the part of the wilderness campers. Many of the sacrifices simply cannot be countenanced by the vacationers, both because their daily lives are an inadequate preparation for the rigors entailed in wilderness camping and because their value orientations find some typical wilderness practices repugnant. Such practices as defecating in the bush and taking drinking water directly from lakes is antithetical to their normal behavior. Contact with the wilderness is an education for many of these individuals in that they realize they cannot exist without conveniences as easily as earlier imagined, especially when conjuring up an image of their struggling with the elements.

Some vacationers who experience the "education" described above will still cling to and cherish their earlier conception of wilderness coexistent with a demand for facilities. They compartmentalize the two belief patterns and repress contradictions, tending to interpret their experiences so that they disturb a previously established viewpoint as little as possible.[8] Incompatible elements are either not perceived by the person, or a satisfactory rationalization of some kind is created to account for the incompatibility. Through this process a self-consistency is maintained.

Some vacationers appear ambivalent, directing antithetical feelings toward the wilderness, one of which is repressed. At one level of cognition wilderness is seen as fascination, as appealing and desirable, while at another level the wilderness represents something to be feared or conquered. These opposing positions are not consciously reconciled, although they are frequently revealed by the manner in which the individual conceives of wilderness as opposed to the management policy he advocates.

From this discussion it must not be construed that all vacationers approach wilderness from an "urban perspective," change their definition of wilderness as a result of a camping experience, or are ambivalent. Interviewing results reveal that a sizable number of campers define wilderness as devoid of man-made conveniences, strongly and consistently opposing management policies directed toward the disruption of such a state.

Implications of the Findings

It is psychologically rewarding to feel that one has, in a sense, successfully struggled with the elements and faced the dangers of the wilds. A sense of selfhood results from doing things on one's own. In this respect the wilderness exerts an appeal—as evidenced in the studies here reported. Yet many vacationers, upon arriving in a wilderness setting, find their everyday lives inadequate preparation for the hardships encountered in camping in undeveloped areas and soon become willing to compromise wilderness or natural qualities to conveniences which will facilitate their camping. This appears to be especially true for campground campers who, more frequently than canoeists, come to the Quetico-Superior in family groups. Even if the men are willing to "really rough it," their wives and children frequently decide otherwise.

One of the major management problems in the Quetico-Superior, as in many other forested areas, is that of preserving the wilderness image which visitors cherish, while at the same time providing minimal facilities to satisfy the most urgent demands of those desiring improvements. The difficulty of such a program lies in the fact that the two policies are, in various respects, incompatible. As greater numbers of campgrounds are developed, toilets built, wells dug, and other "improvements" provided, the wilderness character of the Quetico-Superior will begin to disappear. However, managers in the Superior National Forest find they have little choice but to struggle for an acceptable balance between the two policies, although the Canadian government has adopted a policy of wilderness conservation for the Quetico Provincial Park which allows little or no facility development or canoe-trail maintenance.

One difficulty in the rigid adoption of a wilderness conservation policy lies in the fact that increasing concentrations of people in a given area at a given time, as is increasingly characteristic of many of our forested areas today, seems inevitably to lead to changes, whether such are intended or not. The health and welfare of vacationers must be protected. A lake once furnishing safe drinking water may become unacceptable as several thousand vacationers swarm to its shores. Toilets become just one of of a long list of necessities

[7]Eighty-five percent of the respondents (1958 study) came from urban areas and only 15 percent from rural areas. In fact, 50 percent reported their residences in metropolitan areas with population centers of 500,000 or more.

[8]This process is described by Solomon Asch. Social psychology. Prentice-Hall, Inc. Englewood Cliffs, N. J. p. 441. 1959.

which must eventually accompany increased use of the wilderness. And yet such conveniences cannot become so conspicuous as to destroy the wilderness image which provides an unique appeal drawing vacationers to an area.

The fact that two user groups, with somewhat different attitudes concerning needed developments, are represented in the Quetico-Superior presents an additional problem. In general, the canoeists seek greater isolation, desire fewer improvements, and are more inclined toward preserving the area in a true wilderness state than are the campers. Any deprivation that the two user groups feel upon visiting the area is relative to this difference. The canoeists in search of wilderness are less ready to condone facilities than are those campers who are looking for a good place to pitch their tents near what they consider minimal facilities for their enjoyment and welfare. Even among campers the range of improvements desired varies tremendously.

In looking to the future, it would seen imperative that a better understanding of the motives inducing vacationers to visit forested areas, their attitudes toward these areas, and the benefits derived from their trips be ascertained. Through an understanding of these factors, the forest administrator is better prepared to make an intelligent policy decision governing future recreational development. In some instances, decisions based on long range goals may not meet ready acceptance, although instituted for the public's good. In these cases the forest administrator must have evidence readily at hand to support his decisions, especially if he wishes his policies to be accepted and effective.

Acknowledgment

This study was made possible through financial support from the Quetico-Superior Wilderness Research Center, Lake States Forest Experiment Station, and the Graduate School of the University of Minnesota.

Reclamation of Timberlands Damaged by Oilfield Waste[1]

James W. Curlin and Robert W. McDermid

LARGE ACREAGES of forest land have been damaged in past years by oilfield wastes in the Gulf Coastal region. Although individual salt water kills are predominantly small, ranging from a fractional acre to 120 acres, the total acreage involved is quite formidable. Estimates by interested observers place the total for East Texas alone at over forty thousand acres. Louisiana damages are estimated at eleven thousand acres, and other southern states with oil production have sustained similarly important acreage losses. Legislation designed to correct the situation has been enacted in recent years but the timberlands already removed from production by oil well effluent have not been restored to productivity (Fig. 1). Little work has been undertaken to investigate the reclamation of such damaged lands. Minor (*5*) made a preliminary study of damage in this same area. His observations support the findings of this study.

Oil production from Gulf Coastal fields is characterized by accompanying large volumes of salt water. A ratio of nine barrels of water per barrel of oil is not uncommon (*7*). Although a large number of dissolved inorganic salts are present in this water, the largest portion is sodium chloride; hence the term "brine" as used widely in the oil industry. This brine is often as much as three times more saline than average sea water (*7*).

During 1958, the authors instituted a study on salt-damaged industrial forest lands in Southeast Texas to determine the extent of damage resulting from this cause, and the economic feasibility of reclaiming such lands for future timber production. Three long-established oil-producing areas, the Saratoga, Segno, and Cleveland fields, were chosen for the study.

All three of the oilfields are located in a large area of flatwoods known as the "Big Thicket." It is characterized by level topography with very few well-defined drainageways. Numerous shallow, narrow swales wind about, which seem to comprise the incipient development of a drainage system (*6*). The predominant soils are members of the Caddo soil series. These soils are characterized by a compacted or slightly cemented silty clay or sandy clay fragipan occurring at a depth of 6 to 24 inches.

In order to properly assess methods of reclamation, it was necessary

THE AUTHORS are, respectively, forester, Tennessee Valley Authority, and associate professor, School of Forestry, Louisiana State University.

[1]Acknowledgment is made to Kirby Lumber Co., Houston, Texas, for their cooperation in this project.

FIG. 1.—Timber killed by oil well effluent, Sour Lake Field, Hardin County, Texas. Right photo shows unabsorbed salt water in foreground.

to investigate the following items:

1. The nature of the effluent responsible for the damage.
2. The extent of its retention by the soils of the area.
3. The salt-tolerance of loblolly pine (*Pinus taeda* L.).
4. The physical characteristics of the soils which affect drainage.
5. Methods of removing the chemical residue from these soils.

Procedure

Composite soil samples were obtained from three locations within each affected area sampled. These were:

1. The point of apparent highest salt concentration as evidenced by a salt crust showing at the surface.
2. Within the damaged area, but near the edge of the kills; areas where some mortality had occurred but some living trees still remain.
3. A check sample outside the affected area but within the same soil series.

These soil samples were air-dried, passed through a 2mm. sieve, and thoroughly mixed and quartered for subsequent subsampling.

Undisturbed soil cores were obtained from one representative kill in each of the three oil fields. They included samples obtained from each horizon and well into the pan formation, and were used to determine such physical data as bulk density, permeability, field moisture capacity, wilting point, and noncapillary porosity. Salt water samples were taken from a total of nine producing oil wells

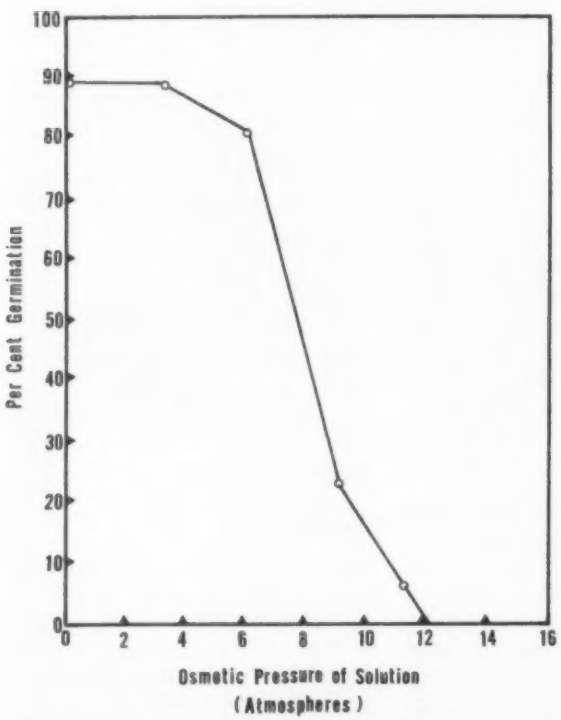


FIG. 2.—Survival of loblolly pine seedlings when grown in solutions of various concentrations of sodium chloride.

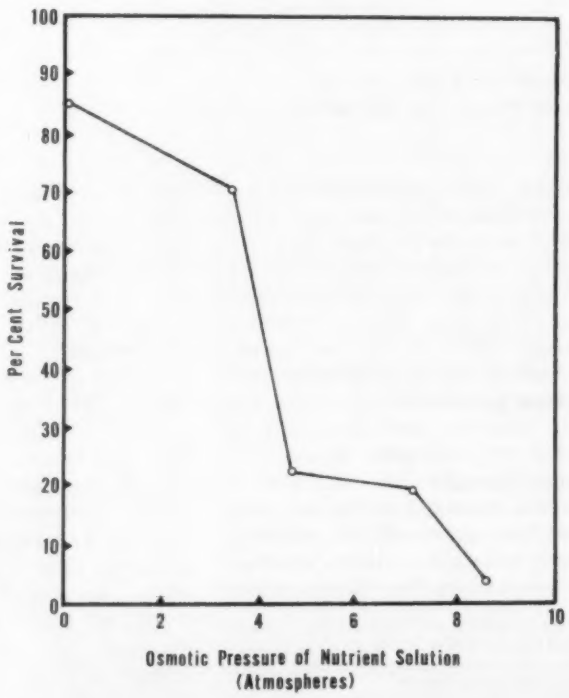


FIG. 3.—Percent germination of loblolly pine seed exposed to various concentrations of sodium chloride solutions.

located adjacent to the sampled areas. From these were determined the mineral concentrations which had caused death of the surrounding vegetation.

Results

Chemical analyses of the soil samples collected revealed large concentrations of dissolved mineral salts remaining in the soil profile, even after years of exposure to atmospheric conditions. These concentrations were far in excess of those obtained from the check samples in the same immediate areas. Salt content of the soils ranged from 32,064 to 143,155 pounds per acre-foot,[2] with the largest portion consisting of sodium chloride. The range of pH of the soil samples from affected areas was acid to strongly acid in reaction. In Table 1 the basic analyses of salt content of the soils tested have been converted from p.p.m. (parts per million) to pounds of salt per acre-foot.

The same salts found in the soils of the damaged areas were obtained from analysis of the water taken from the adjacent oil wells, and in the same relative distribution.

A companion study was initiated to determine the tolerance of loblolly pine seedlings to sodium chloride. Analysis of variance of the data indicates that the minimum lethal concentration of NaCl in the soil solution, for one-year-old loblolly pine seedlings lies between 4,575 and 7,131 p.p.m. (3.4 to 4.6 atmospheres of osmotic pressure). Figure 2 graphically illustrates the results of this study.

Tests were also run to establish any real differences in germination of loblolly pine seed due to NaCl concentration. Here again it was found that the critical concentration of NaCl solution which imparts a deleterious effect on germination lies somewhere above 4,575 but below 9,740 p.p.m. (3.4 to 6.0 atmospheres). Figure 3 represents the results of the germination test.

The high concentration of residual salts contained in the affected soil is manifest in Table 1.

[2]An acre-foot is assumed to weigh 4,349,000 lbs. (Bulk density 1.60.)

TABLE 1.—SALT CONTENT OF SOILS TESTED

Location	Total salt	Total salt
	Pounds per acre foot	*Percent by wt.*
Segno Field		
Dorrance	115,823	2.66
Hooks	32,064	0.74
Wing I	73,575	1.70
Saratoga Field		
Fuller	38,222	0.88
Hardin	97,340	2.24
Cleveland Field		
McCoy	143,155	3.30

The question then arises as to possible courses of action to reclaim such areas for future timber production.

Discussion

The reclamation of saline soils depends upon the effective removal of the soluble salts by leaching with water and possible soil amendments to displace harmful minerals from the soil complex. Zurr (*8*) found in the Netherlands that soils inundated by the sea and containing about 2 percent NaCl (20,000 p.p.m.) can be reduced in the wet Dutch climate to 0.1 percent or less in two years.

The most critical problem encountered in the reclamation of saline soils is inadequate drainage. The drainage characteristics of the affected areas sampled indicates extremely poor permeability within the soil profile. In order to implement the leaching of soluble salts, it is evident that steps must be taken to improve the drainage characteristics of the soil.

Among the types of drainage structures which are used to improve water movement are: drainage ditches; mole drains; ceramic tile drains; plastic tile drains.

Open ditches have been used successfully to drain timberlands along the Atlantic Coast (*4*) and in the Scandinavian countries (*3*). There is, however, the problem of access to and through the areas separated by such ditches.

Mole drainage designed to improve internal drainage in the soil is used extensively in Europe. A torpedo-like "mole" is pulled through the soil behind a subsoil attachment, leaving a cylindrical hollow tunnel in the soil to receive and discharge water into drainageways. This device is not effective in very loose soils where the channel produced by the mole will collapse nor in heavy plastic soils where its passage may seal the soil to water movement.

Ceramic tiles are entirely adequate and are used extensively in agricultural improvements. Their installation cost, however, precludes use in this instance under the existing price structure for forest products.

Bush (*1*) has described a machine which has recently been developed to enable the laying of a plastic tile liner in a mole-like tunnel in a single operation. The machine consists of a mole-plow which has been modified to permit a strip of vinyl material .015-inch thick by 6 inches wide to be fed into the mole to form an arch shaped liner. The plastic is perforated on the upper side to allow inflow of water into the channel. The machine is drawn by a crawler-type tractor of approximately 50 drawbar horsepower. Bush and Edminster (*2*) estimate the entire cost of installing such plastic drain at 7 to 8 cents per foot; approximately 4½ cents of this amount being the cost of the plastic.

In final analysis, reclamation and reforestation of areas damaged by oilfield brine can only be undertaken if the appraised present worth of future timber crops is commensurate with the investment in the crop. In order to quantify results, a hypothetical problem has been developed.

It is assumed that a damaged area has a potential 80-foot site index for loblolly pine and that, upon reclamation, the productivity of the land is fully restored. The timber will be managed on a 50-year rotation and is assumed to produce approximately 75 percent of a normal yield. Loblolly pine seedlings will be planted after the soil is fully reclaimed. This reclamation will be accomplished by the installation of subsurface plastic tile pipes, spaced one chain (66 feet) apart. The period required for removal of enough salt to return the soil to a productive status is assumed to be five years. The discount rate is 4 percent. Costs and yields are shown in Table 1.

Thus, at the end of the first rotation, a small profit could be expected. Subsequent rotations without these extraordinary expenses should produce normal profits.

TABLE 1.—COSTS AND YIELDS

Item assumed	Unit value or cost	Value per acre	Interest added	Value of income or cost at rotation	
Income					
Yield at rotation 11,250 bd. ft. Scribner (6)	$30/MBF	$337.50		$337.50	
Thinnings					
(a) age 20 4 cords	4.25/cd.	17.00	$(1.04)^{50}$	55.14	
(b) age 25 5 cords	4.25/cd.	21.25	$(1.04)^{45}$	56.65	
(c) age 30 5 cords	4.25/cd.	21.25	$(1.04)^{40}$	145.16	
1,500 bd. ft.	30/MBF	45.00			
(d) age 40 2,000 bd. ft.	30/MBF	60.00	$(1.04)^{10}$	88.81	
Total income at rotation age					$683.26
Expenses					
Cost of drainage 612 feet of plastic tile	$0.08/ft.	48.96	$(1.04)^{55}$	$423.33	
Planting		13.00	$(1.04)^{50}$	92.39	
Administration		0.85	$(1.04)^{55}-1$	162.49	
			.04		
Total cost at rotation age					$678.21
Net income at rotation age					$ 5.05

Literature Cited

1. BUSH, CHARLES D. 1957. Developments in low cost sub-surface drainage. Paper presented at North Atlantic Sect. Am. Soc. Agric. Engrs. Univ. of Delaware, Newark. 8 pp.
2. ————, and T. W. EDMINSTER. 1958. Low cost subsurface drainage installation. Paper presented at Building Res. Inst. 7th Ann. Meeting. April 1958, Washington, D. C. 5 pp.
3. HUIKARI, OLAVI. 1959. Drainage of swamp lands for forestry purposes in Finland. Jour. Forestry 57: 128-129.
4. MAKI, T. E. 1960. Improving site quality by wet-land drainage. Southern Forest Soils, pp. 106-114. Louisiana State University Press, Baton Rouge.
5. MINOR, C. O. 1957. A preliminary study of damage to forest land by salt-water from oil operations. Unpublished Report. Duke University, School of Forestry. 18 pp.
6. SCHUMACHER, F. X., and T. S. COILE. 1960. Growth and yield of natural stands of the southern pines. T. S. Coile, Inc., Durham, N. C. 106 pp.
7. SMITH, H. M., et al. 1930. Soil survey of Polk County, Texas. Bur. of Chem. and Soils. U. S. Dept. Agric. No. 36.
8. TAYLOR, S. S., and E. O. OWENS. 1942. Subsurface disposal of oil field brine in Oklahoma. U. S. Bur. of Mines. RI 3603. 54 pp.
9. ZURR, A, J. 1952. Drainage and reclamation of lakes and of the Zuiderzee. Soil Science 74: 75-89.

Water Use by Brush, Grass, and Grass-Forb Vegetation

P. B. Rowe and L. F. Reimann

A PLOT study on the San Dimas Experimental Forest[1] in the San Gabriel Mountains of southern California shows wide differences in seasonal and annual evapo-transpiration from deep soil beneath oak-brush, annual grass, or grass-forb covers. These differences in water loss have implications important to the watershed manager. They indicate that under favorable conditions water yield can be increased through conversion from brush to grass. The amount of increase that can be obtained depends on such conditions as depth and water storage capacity of the soil, amount and distribution of annual rainfall, and kinds of vegetation occupying the site before and after conversion.

Methods and Conditions of Study

Three triplicate sets of 1/40-acre plots, each 10 feet wide by 108.9 feet long, were used in the study. The plots have an average gradient of 35 percent, and are situated on the lower part of an east-facing slope at an elevation of about 2,800 feet. The soil is a permeable, stony, sandy loam averaging about 12 feet deep. Annual rainfall averages 27.5 inches and occurs mostly in the four winter months of December through March.

The original vegetation on the plots was dense scrub oak chaparral unburned since 1919 (Fig. 1 *Left*). Average spring density of this cover was:

	Percent of ground shaded
Brush	42
Grasses and herbs	1
Litter	98
Bare soil	1

The brush cover consisted of 61 percent California scrub oak (*Quercus dumosa*), 27 percent birch leaf mountain mahogany (*Cercocarpus betuloides*), 10 percent hoaryleaf ceanothus (*Ceanothus crassifolius*), and 2 percent other species. The herbaceous cover was principally coast range melic (*Melica imperfecta*), and chilicothe mock cucumber (*Echinocystis macrocarpa*).

Before the start of the study, records of rainfall, surface runoff, erosion, and soil moisture were obtained on the plots for several years. An intensive study of the amount of storm rainfall intercepted and lost as direct evaporation from the vegetation was also carried out during this calibration period (*2*).

In February 1952, two of the three sets of triplicate plots were hand cleared of brush and sown (once in February and again in April) to Italian ryegrass (*Lolium multiflorum*). However, a duff cover (ranging from a trace up to 5 inches in depth) remained on the soil after the brush was removed. This duff prevented the establishment of a satisfactory grass stand that spring. In the fall of 1952 most of the duff was removed by hand, that remaining was burned with a torch, and the plots were resown. This sowing, together with volunteer native grasses, resulted in a good stand the following growing season (Fig. 1 *Right*) and a heavy mulch of dead grass during the rainy season of 1953-1954. Throughout the study, the third set of triplicate plots was maintained as a control with the natural brush vegetation undisturbed.

During the first 3 hydrologic years (October 1, 1951 through September 30, 1954), an essentially weed-free grass cover (Fig. 2) was maintained on the converted plots. This was accomplished by repeated sprayings of the brush sprouts, seedlings, and forb growth with 2,4,5-T. The plots were not sprayed during the 1954-1955 growing season, and a heavy stand of summer-growing forbs developed (Fig. 3). These forbs considerably changed the density and composition of the vegetation on the plots (Table 1).

Rates and amounts of storm rainfall, surface runoff, and erosion were measured in all plots. Soil moisture was also measured, after each storm and at weekly intervals during interstorm periods, by means of electrical resistance soil moisture units (*1*). The units were installed at 1½-, 4½-, 9-, 15-, 21- and 30-inch depths, and at 12-inch spacings from 30 inches to bedrock at an average depth of 12 feet. The unit readings were checked periodically by gravimetric sampling. Evapo-transpiration, including interception loss, and percolation through the 12-foot soil depth were computed from the measurements of rainfall and changes in soil moisture between successive sampling dates using methods described by Rowe (*4*) and Rowe and Colman (*6*).

How Conversion from Brush to Grass Affected Surface Runoff and Erosion

During the process of conversion from brush to grass before a complete grass cover was established small increases in surface runoff and erosion occurred. In the spring of 1952 five storms yielding 9.6 inches of rainfall occurred within 24 days after the brush had been

THE AUTHORS are with the Pacific Southwest Forest and Range Expt. Sta., Forest Service, U. S. Dept. Agric., Berkeley, Calif.

[1]San Dimas Experimental Forest, a 17,000-acre field research laboratory on the Angeles National Forest, is maintained by the Forest Service, U. S. Dept. Agric., in cooperation with the Division of Forestry, Department of Natural Resources, State of California.

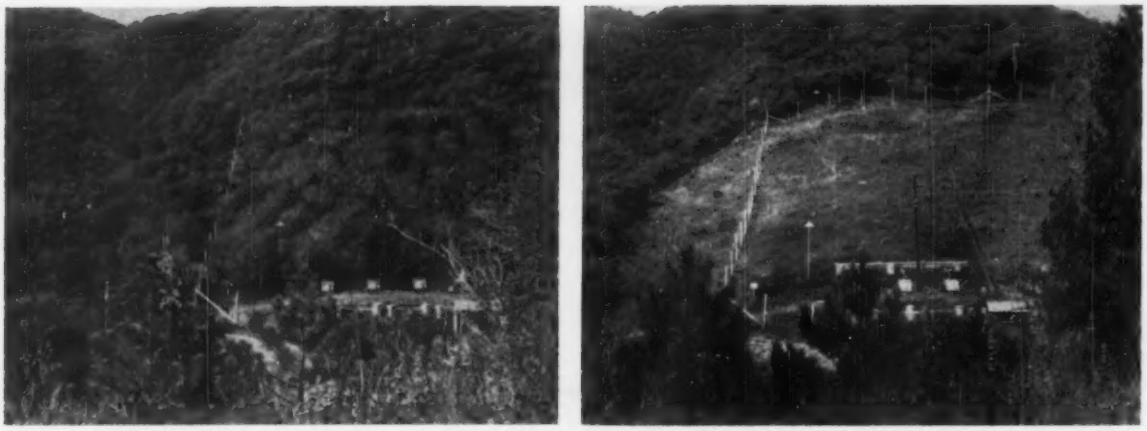


FIG. 1.—Vegetation on plots: *Left*—January, 1952 just before brush was removed. *Right*—May, 1953 after successful establishment of Italian ryegrass cover. A triplicate set of plots maintained with the natural vegetation undisturbed is situated out of the photograph just to the right of the cleared area. (JSH 596, 635)

removed and the plots first seeded to Italian ryegrass. About one-half of 1 percent of this rainfall was measured as surface runoff from the cleared plots.

In the fall of 1952, a small but intense storm yielding 1.7 inches rainfall occurred shortly after the old brush litter had been removed and the plots reseeded the third time. Surface runoff from the bared, freshly sown grass plots was about 2.2 percent of the storm rainfall, and produced erosion (duff, ash, and soil) at a rate of approximately 2½ tons per acre (Fig. 4).

Since establishment of a complete grass cover, there has been no appreciable amount of runoff or water-carried erosion from the plots. Water losses and soil moisture relations, however, have been markedly altered by the changes in vegetation.

How Conversion Affected Evapo-transpiration the First Summer

The 40.5 inches of rainfall during the winter rainy season of the 1951-1952 hydrologic year wet through the 12-foot depth of soil on all plots. Most of this rain fell before the brush had been removed and a grass cover could be established on the cleared plots. Hence it can be assumed that the conversion from brush to grass had no appreciable effects on water yield this first rainy season.

During the succeeding (1952) summer the soil of the brush plots dried below field capacity to the full 12-foot depth, and to or below wilting point to about 84 inches (Fig. 5). In contrast, the soil of the grass plots, which during this period still had nearly a complete cover of old brush litter, dried below field capacity to a depth of only about 84 inches, and to or below wilting point to only 26 inches. At the end of the drying period, moisture remaining in the upper 30 inches of soil was about

FIG. 2.—Vegetation on grass plots, May 15, 1953 after native annual grasses had matured and the Italian ryegrass comprising about 84 percent of the stand was just beginning to head.

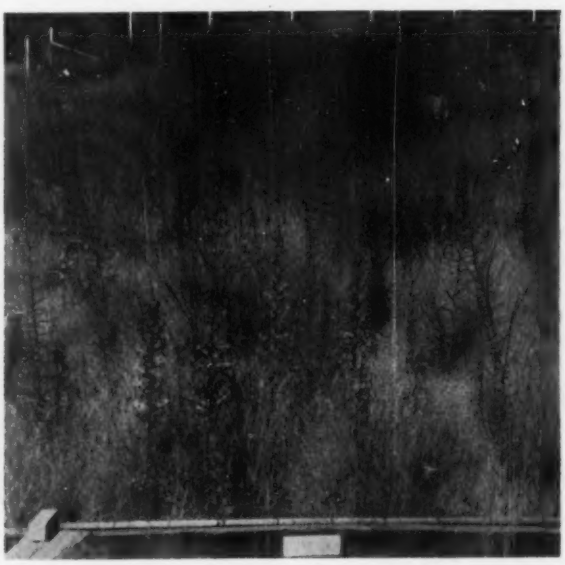


FIG. 3.—Vegetation on the grass plots in late July 1955, the first year after control of the forb growth was discontinued. At the time of this photograph the annual grasses had died and the summer growing forbs were approaching maturity. The taller forbs were mostly *Stephanomeria virgata*.

the same for all plots. The carry-over of water in the 30- to 144-inch depth of soil, however, was 8.8 inches greater for the grass than for the brush plots. Summer water storage at the start and end of the drying period, and summer evapo-transpiration were:

	Brush plots (In. depth)	Grass plots (In. depth)
Water storage—Start of drying (4/30/52)	29.1	30.0
Water storage—end of drying (11/1/52)	13.4	22.2
Rainfall	0.6	0.6
Summer evapo-transpiration	16.3	8.4

These data indicate nearly an 8-inch greater evapo-transpiration from the brush than from the grass-covered soil. The differences in this loss can be attributed principally to two circumstances: (1) the brush continued use of water over a longer period than the grass, and (2) the brush used more water from the 30- to 144-inch soil depths.

How Conversion Affected Evapo-transpiration During a Year of Low Rainfall

The 15.5 inches of rainfall during the 1952-1953 rainy season was not enough to produce percolation through the soil of either the brush or grass plots. Soil of the brush plots was wet to field capacity to an average depth of only 42 inches, but it was wet to above wilting point throughout its full depth (Fig.5). The soil of the grass plot was wet to field capacity to an average depth of 72 inches by this year's rain. From 72 to 84 inches the soil moisture remained above the wilting point and below 84 inches at or near field capacity.

By the end of the 1953 summer drying period, moisture in the brush-covered soil was again reduced to near or below the wilting point throughout the entire 12-foot depth. That of the grass-covered soil, from which the litter and grass mulch had been completely removed the previous fall, dried to or below wilting point to a depth of 42 inches, and below field capacity to about 86 inches.

The upper 44 inches of soil in both the grass and brush plots dried to about the same moisture content. Below 44 inches the grass-covered soil retained nearly 12 inches more water than the brush-covered soil. Water in storage at the start and end of the 1952-1953 hydrologic year and annual evapo-transpiration were:

	Brush plots (In. depth)	Grass plots (In. depth)
Water storage—start of year (11/2/52)	13.4	22.2
Water storage—end of year (10/18/53)	9.9	21.6
Rainfall	15.5	15.5
Percolation through the soil	0.0	0.0
Evapo-transpiration	19.0	16.1

Results during this second year of study show that percolation through the soil, in this season of low rainfall, was not increased by manipulation of the vegetative cover. Rainfall was not in excess of that required to wet through the root zone and satisfy current evapo-transpiration loss.

How Conversion Affected Evapo-transpiration During a Year of Moderate Rainfall

Rainfall of the hydrologic year 1953-1954 was 24.9 inches, about 92 percent of which occurred in the 80-day period from January 11 through March. This rainfall wet through and produced percolation from the soil of the grass plots. But the rainfall was not enough to fully wet through the drier soil of the brush plots (Fig. 5).

FIG. 4.—Cleared plots showing rill-wash following a small intense storm occurring in the fall of 1952 before a grass cover had been established.

As in previous summers, the soil of the brush plots was dried to near or below wilting point through the entire 12-foot depth. Soil of the grass plots dried to or below wilting point to an average depth of only 25 inches and below field capacity to about 84 inches. The grass cover, particularly the Italian ryegrass, was less dense and the mulch cover was much heavier this summer than in 1953 (Table 1). Water in storage at the start and end of the year, percolation through the soil, and annual evapo-transpiration were:

	Brush plots (In. depth)	Grass plots (In. depth)
Water storage—start of year (10/19/53)	9.9	21.6
Water storage—end of year (11/8/54)	11.4	24.6
Rainfall	24.9	24.9
Percolation through the soil	0.0	6.4
Evapo-transporation	23.4	15.5

These figures indicate the possibility of higher peak discharges from the grass than from the brush-covered soils during the wetting period each year. In southern California watersheds, flood hazards increase as the wetness of the soils increases. The greater carry-over of water in the grass-covered soil, therefore, poses a

TABLE 1.—DENSITIES OF VEGETATION COVER AT THE PEAK OF EACH YEAR'S SPRING GROWTH,[1] TANBARK FLAT GRASS AND GRASS-FORB PLOTS, 1952 THROUGH 1956

Vegetation cover	Grass			Grass-forb	
	1952	1953	1954	1955	1956
	Percent				
Italian ryegrass	33	53	27[2]	37	14
Red brome[3]	4	4	14	17	19
Other grasses[3]	5	6	3	6	14
Forbs	20.0[4]	T	0	9	8
Total—Grass-forb cover	62	63	44	69	55
Old duff, stumps, etc.	90	1	1	1	1
Grass and grass-forb litter	T	T	63	75	97
Total—Duff and litter cover	90	1	64	76	98
Total ground covered (vegetation and litter)	98	64	86	95	99

[1]Vegetation generally charted during early May when native annual grasses are fully matured. Italian ryegrass just beginning to head, and summer growing forbs mostly small or just starting growth.

[2]Exceptionally dry spring growing season resulted in poor stand of Italian ryegrass (rainfall March 31 through June 30, 0.22 inches).

[3]In addition to red brome (*Bromus rubens*) the native grass cover includes such species as: foxtail fescue (*Festuca megalura*), constrange melic (*Melica imperfecta*), cheatgrass brome (*Bromus tectorum*), and several others in lesser amounts.

[4]Includes brush sprouts, seedlings, and forb growth not completely eliminated from stand at time of charting.

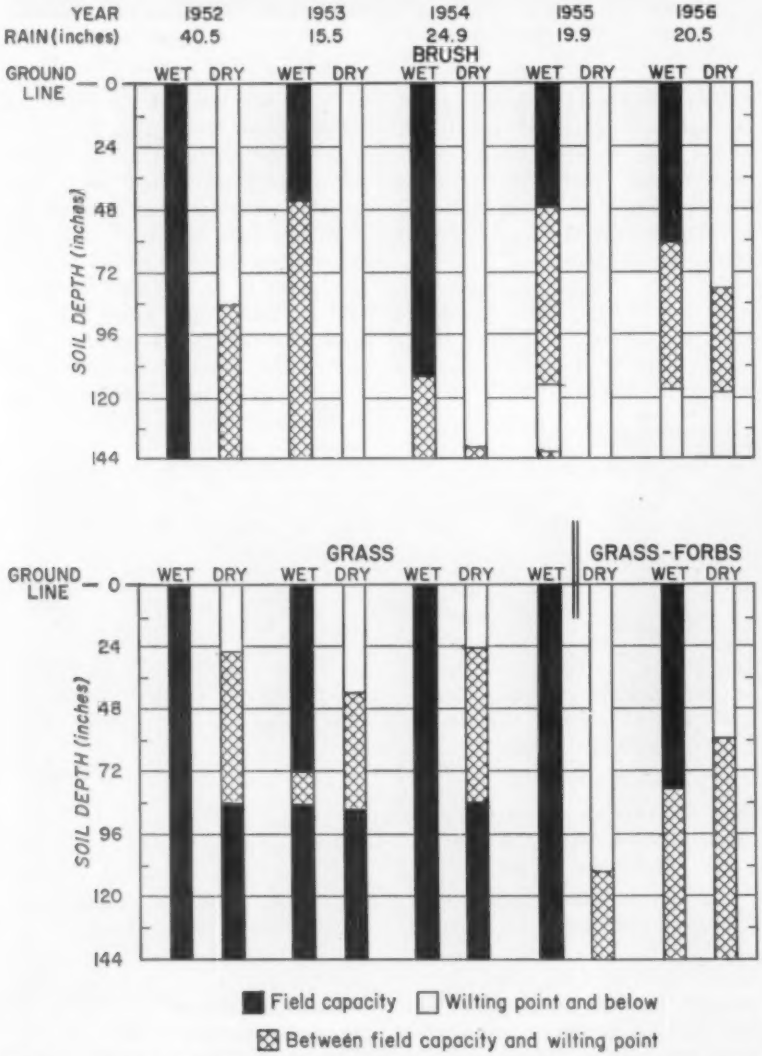


FIG. 5.—Annual soil wetting and drying under brush, grass, and grass-forb vegetation covers.

threat of increased runoff until the brush-covered soil is wet to field capacity throughout the root zone. When both soils are completely wet, there should be small differences in the effects of soil moisture on flood peaks. It is during such periods that heavy rainfall and floods are most likely to occur.

The carry-over of water in the soil of the brush plots was 1.5 inches greater and in the grass plots about 3.0 inches greater at the end of the 1954 drying season than at the end of the previous drying season. One reason for the increase may have been the heavy and concentrated rainfall during the rainy season. The difference in increased carry-over between grass and brush plots, however, appears to be due largely to: (1) a reduction in the direct evaporation from the soil of the grass plots owing to the development of a heavy mulch cover (*4, 5*), and (2) a reduction in transpiration use because of the nearly 50 percent decrease in the late maturing, Italian ryegrass fraction of the grass cover (Table 1).

From these results we can reason that the condition of a grass cover and the way it is managed have important effects on water yield. The watershed manager will recognize that in deep soils conversion from brush to grass can result in increased water yield. The increase probably results because the grass has shallower roots and a shorter growing period than the brush. To realize an increase in water yield, however, soils must be deeper than the root penetration by the grasses, and rainfall must exceed that required to wet through the soil and satisfy current evapotranspiration.

How Conversion Affected Evapotranspiration when Forb Growth was Uncontrolled

Rainfall during the 1954-1955 rainy season amounted to 19.9 inches and occurred in a series of small widely distributed storms. This occurrence of storms, extending from November 10 through May, resulted in a comparatively high evapo-transpiration loss during the rainy season. The rainfall did not wet through the soil of the

brush plots and probably would not have done so even if it had occurred over a shorter period. It did, however, wet and result in percolation through the soil of the grass plots.

This year, for the first time, forb growth on the grass plots was not controlled. As a result, a heavy stand of summer growing forbs, principally *Stephanomeria virgata*, invaded the plots (Fig. 3). By the end of the summer the *Stephanomeria* had reached an average growth of 2 to 4 times its normal height. The reasons for this accelerated growth are not known, but two probable reasons are: (1) the large supply of available water remaining in the soil after the annual grass matured, and (2) 2,4,5-T remaining in the soil in sufficiently low concentrations to act as a growth-promoting substance.[2] Other forbs invading the plots in lesser numbers did not show accelerated growth. They included: common yellow mustard (*Brassica campestric*), prickly lettuce (*Lactuca serriola*), Douglas nightshade (*Solanum douglasi*), soap plant (*Chlorogalum pomeridianum*) and Sierra thistle (*Cirsium californicum*).

By the end of summer the grass and invading forb cover had dried the soil below field capacity throughout the full 12-foot depth, and to or below wilting point to 110 inches. Total evaporative loss this year was about 9 inches more from the grass-forb than from the brush-covered plots. The brush cover as usual dried the soil to or below wilting point throughout its full depth. Water in storage at the start and end of the year, percolation, and annual evapo-transporation were:

	Brush plots	Grass-forb plots
	(In. depth)	(In. depth)
Water storage—start of year (11/9/54)	11.4	24.6
Water storage—end of year (11/8/55)	10.7	13.2
Rainfall	19.9	19.9
Percolation through the soil	0.0	1.7
Evapo-transpiration	20.6	29.6

[2]Dr. Henry Hellmers, plant physiologist, Pacific Southwest Forest and Range Expt. Sta., who inspected the plots, believes that this conclusion is supported by the fascitation—one of the first symptoms of hormone action—which he observed in these plants.

During the next rainy season (1955-1956) nearly half of the 20.5 inches of rainfall occurred in one 3-day storm in late January. The remainder of the rainfall occurred in a series of small, widely spaced storms. Because rainfall was low and the soil extremely dry at the start of the rainy season, there was no water yield from either the brush or grass-forb plots. The soil of the brush plots was wet to field capacity to a depth of only 60 inches and that of the grass-forb plots to a depth of only 78 inches.

At the end of summer drying moisture in the soil of the brush plots had dropped to or below wilting point to a depth of 78 inches and that of the grass-forb plots to a depth of 60 inches. The carry-over of moisture in the soil under the brush cover was 2.3 inches greater than in 1955; in the soil under the grass-forb cover, 3.5 inches greater. The reason for this increase in water carry-over could not be determined. The greater increase in the grass-forb than in the brush plots, however, appears to have been caused by: (1) the large reduction in the densities and growth of *Stephanomeria* and Italian ryegrass this year as compared to 1955, and (2) the increase in the mulch cover on the grass plots (Table 1). Water in storage at the beginning and end of the hydrologic year, percolation and evapo-transpiration were:

	Brush plots	Grass-forb plots
	(In. depth)	(In. depth)
Water storage—start of year (11/9/55)	10.7	13.2
Water storage—end of year (11/30/56)	13.0	16.7
Rainfall	20.5	20.5
Percolation through the soil	0.0	0.0
Evapo-transpiration	18.2	17.0

The results of 1954-1955 and 1955-1956 support those of previous years and show that on the deep soils conversion from brush to grass resulted in more water yield. Such increases in yield were obtained, however, only when the growth of brush, forbs, and other deep-rooted plants was prevented.

How Conversion Affected Evapo-transpiration Rates

The conversion from brush to grass increased evapo-transpiration rates and hence total losses (interception loss plus evapo-transpiration) during each rainy season (about November 2 to April 20). Daily evapo-transpiration from the brush plots during this period was .048 inch and from the grass and grass-forb plots .059 inch. This amounted to an average annual increase in the rainy season loss of about 2 inches. Most of the increase in loss occurred during the period from late January through early April when the scrub oak growth was slow and annual grass growth relatively rapid (Fig. 6). Rainy season evapo-transpiration by years was:

	Brush plots (In. depth)	Grass plots (In. depth)
11/2/52-3/23/53 (141 days)	5.7	9.6
10/19/53-4/10/54 (173 days)	8.6	9.6
11/9/54-5/10/55 (182 days)	10.2	12.1
11/9/55-5/11/56 (183 days)	8.0	9.1[3]

In the 1952-1953 season the grass plots had a heavy growth of grass but practically no mulch or litter cover. The rainy season evapo-transpiration from the grass was 3.9 inches more than from the brush plots. In the 1953-1954 and 1955-1956 season when the grass plots had heavy covers of mulch but a poor growth of grass, particularly of Italian ryegrass, rainy season evapo-transpiration averaged only about 1.0 inch more than from the brush plots. Thus the kind and density of the grass cover and the amount of mulch remaining on the soil had important effects on rainy season water loss and water yield (*3, 4*).

Owing to the higher rainy season evapo-transpiration rates from the grass cover, conversion from oak-brush to grass on shallow soil could very well result in less water yield. This would have occurred on the plots, had the soil been of insufficient depth to permit a carry-over of enough available moisture below the reach of the grass roots to compensate for the increased rainy season losses.

Summer evapo-transpiration losses, reversing the winter picture, were far greater from the brush

[3]Forb growth not controlled.

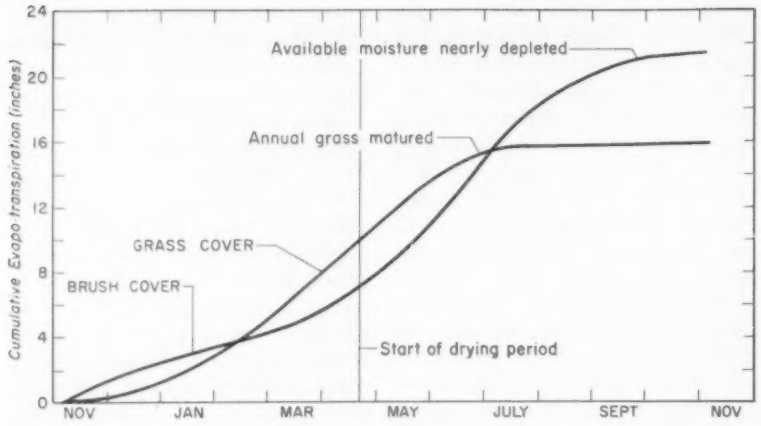


FIG. 6.—Generalized accumulated annual evapo-transpiration from the 12-foot soil depth of the scrub-oak and grass-covered soils during years of low to moderate rainfall (1952-1953 and 1953-1954).

than from the grass plots. Evapo-transpiration from the grass plots practically ceased each year when the annual grass reached maturity in early summer (Fig. 6). Loss from the brush plots continued throughout the summer, or until all available moisture in the 12-foot soil depth had been utilized. Drying season evapo-transpiration by years was:

	Brush plots	Grass-forb plots
	(In. depth)	(In. depth)
4/30/52-11/2/52 (186 days)	16.3	8.4
3/23/53-10/19/53 (210 days)	13.3	6.5
4/10/54-11/9/54 (213 days)	14.8	5.9
5/10/55-11/9/55 (183 days)	10.4	17.5[1]
5/11/56-11/30/56 (204 days)	10.2	7.9[1]

During the first three drying periods (about April 20 to November 6) average daily evapo-transpiration from the brush plots was .073 inch and from the grass plots .034 inch. This amounted to an average annual decrease in the drying period water losses from the plots converted to grass of about 7.9 inches.

Had rainfall been enough to wet through the soil of the brush plots each year, the difference in summer losses between the brush and grass soils would have been greater. For example, the decrease in evapo-transpiration was 8.9 inches in 1954—when annual rainfall was 24.9 inches—and 6.8 inches in 1953—when rainfall was only 15.5 inches. In the drying period of 1953 the grass cover was relatively heavy and the mulch cover extremely sparse (Table 1) as compared to the summer of 1954. Hence the same factors that influenced rainy season evapo-transpiration rates, amount and distribution of rainfall, kind and density of the grass cover, and amount of mulch on the soil, are also important in the control of the drying season water losses.

In 1955 when weeds as well as grasses were permitted to grow on the grass plots, summer evapo-transpiration was greatly increased. Average daily evapo-transporation from the brush plots in the 1955 drying season was .057 inch, and from the grass-forb plots .096 inch. This amounted to 17.5 inches of water loss from the grass-forb plots, or 7.1 inches more than from the brush-covered soil. The large loss from the grass-forb plots was possible only because of the high carry-over of water stored in the soil during previous seasons when the plots were under pure grass cover.

In the summer of 1956 the moisture available to evapo-transpiration in the brush and grass-forb plots was nearly the same. However, the herbaceous cover on the grass-forb plots, particularly that of the Italian ryegrass and the *Stephanomeria*, was much lighter and the mulch cover much heavier than that of 1955. As a net result, evapo-transpiration from the brush this summer was 2.3 inches greater than from grass-forb covered soil.

[1]Forb growth not controlled.

Some Applications of the Study to Watershed Management in Brush Lands

This study on the San Dimas Experimental Forest in the San Gabriel Mountains of southern California shows differences in seasonal and annual evapo-transpiration loss and water yield from deep soil beneath oak-brush, annual grass, and grass-forb covers.

The results indicate that water yield cannot be appreciably increased in years of low rainfall or from shallow soils—soils less than 3 feet deep—by converting oak-brush cover to grass. In fact, conversion from brush to grass on shallow soils would more likely result in reduced than in increased water yield because of higher evapo-transpiration from the grass during the rainy season. On deep soils—soils over 3 feet deep—conversion from brush to grass can result in appreciable increases in water yield during years of rainfall sufficient to wet through the soil and satisfy current evapo-transpiration losses. The deeper the soil up to the depth brush roots can reach, the greater is the opportunity of increasing amounts of water yield.

Optimum increases in water yield are also dependent on management practices that maintain a protective mulch cover and prevent regrowth of brush or the invasion of forbs and other deep-rooted plants.

From these findings we can reason that the management of vegetation to increase water yield is like farming. To be successful and economically feasible, it must be limited to areas with conditions of rainfall, soil, and vegetation capable of yielding the desired results.

Literature Cited

1. COLMAN, E. A., and T. M. HENDRIX. 1949. The fiberglass electrical soil-moisture instrument. Soil Sci. 67(6): 425-438. Illus.
2. HAMILTON, E. L., and P. B ROWE. 1949. Rainfall interception by chaparral in California. Calif. Dept. of Nat. Resources, Div. of Forestry. 43 pp. Illus.
3. KITTRIDGE, JOSEPH. 1948. Forest in-

fluences. McGraw-Hill Book Co. Inc., New York. 394 pp. Illus.
4. ROWE, P. B. 1948. Influence of woodland chaparral on water and soil in central California. Calif. Dept. Nat. Resources, Div. of Forestry. 70 pp. Illus.
5. ————. 1955. Effects of the forest floor on disposition of rainfall in pine stands. Jour. Forestry 53: 342-348. Illus.
6. ————, and E. A. COLMAN. 1951. Disposition of rainfall in two mountain areas of California. U. S. Dept. Agric. Tech. Bul. 1048. 84 pp. Illus.

Changes in Form Class in a Red Pine Plantation

Allen F. Horn

THE FOREST Management Department of the State University of New York College of Forestry maintains a series of growth plots within the plantations of the Great Bear Springs near Fulton, N. Y. These plantations are of particular interest to foresters in the Northeast because they are among the earliest plantings in the area and are now approximately 50 years old. The stands were established between 1906 and 1913 by the then owner of the Great Bear Springs Company to protect the purity of the spring water which was widely distributed to cities in the Northeast. Species planted included Scotch, white, red, and ponderosa pine, Japanese and European larch, and Norway spruce. Over this period about 213 acres of land were planted.

The first growth plot was established by the College of Forestry in 1918 under the supervision of Professor H. C. Belyea. This initial work continued until 1922 when a total of eight plots had been set up in various stands. Unfortunately, only one quarter-acre plot was established in each stand so the inferences that can be drawn from these records are limited. The usual measurements of d.b.h. crown position and height of sample trees were taken at 10-year intervals with the exception of a 5-growing season period between 1932 and 1938. Volumes were derived on the basis of stem analyses of average trees curved to read in terms of cubic volume/basal area.

During the 1958 measurement season it was decided to investigate the possible use of form class volume tables in order to recognize this important variable in determining tree volume. The investigation was limited to a study plot in a plantation of red pine that had been planted in 1909 at a spacing of 6×6 feet.

The trees selected for measurement of Girard form class were chosen on the basis of crown position. Trees that had been dominant for three or more measurement periods were segregated in one group. Those that had been in a dominant position during the past two measurement periods comprised a second group, and trees that were codominant for three or more measurement periods were placed in a third group. No trees in the intermediate and suppressed classes were included because there were too few of these trees in the plot to obtain reliable estimates of form class.

Girard form class of the present stand was measured in the usual fashion, $\frac{\text{d.i.b. @ top of 1st log}}{\text{d.b.h.}} \times 100$ with an allowance of one foot for stump height. In order to obtain d.i.b. at the top of the first log for corresponding measurement periods in the past, increment borings to the center of the tree were taken at this point. Tree diameter as measured by the increment core was compared to the diameter as measured by the tape less double bark thickness. The resulting correction factor was applied to the increment core length to adjust for displaced heart center. By counting back to the rings representing 1948, 1938, and 1932 and multiplying by the appropriate correction factor, the d.i.b. at these years could be determined. These measurements d i v i d e d by the d.b.h.'s of the sample trees which had been measured directly at the time of periodic inventory gave the past Girard form classes of these trees.

The average Girard form class for each of the three crown position groups was calculated for the years 1958, 1948, 1938, and 1932. Except for the 1932 measurement it was found that there was less than one form class difference between trees that were dominant for three or more measurement periods and those dominant during the last two periods. Therefore, these two groups were combined, and with average codominant values they were plotted as Girard form class over year of measurement as shown in Figure 1.

Implications

In 1932 this stand was 23 years old. The one-quarter acre study plot represented conditions of 976 stems and 164 square feet of basal area per acre. The tree of average basal area was 5.5 inches d.b.h. (See Table 1 for a more complete summary of average stand conditions). The difference in average

THE AUTHOR is assistant professor, Department of Forest Management, State University of New York College of Forestry at Syracuse University, N. Y.

TABLE 1.—AVERAGE PER ACRE STAND CONDITIONS FOR RED PINE PLANTATION PLANTED IN 1909 AT A SPACING OF 6×6 FEET

Year	Number of of trees	Basal area	Height of dominant tree	D.b.h.	Girard form class dominants	Girard form class codominants
		Sq. ft.	*Feet*	*Inches*		
1918	1172	18	----	----	----	----
1922	1172	89	----	3.7	----	----
1932	976	164	38	5.5	73.1	66.7
1938	916	192	45	6.2	78.9	75.9
1948	764	194	56	6.8	84.5	82.5
1958	288	98	62	7.9	82.5	81.2

Girard form class between the dominant and codominant elements of the stand was approximately 6 numbers (66.7 and 73.1).[1] This difference would represent an error of about 12 percent in volume if the same table used to calculate the volume of dominant trees was also used for codominant trees. Each difference in Girard form class indicates a 2 to 3 percent change in volume, depending upon tree diameter.

During the ensuing 15 growing seasons stand structure changed markedly. On the basis of study plot information, by 1948 at age 39, there were only 764 trees per acre. However, the basal area was 194 square feet per acre, and the tree of average basal area was 6.8 inches d.b.h.. The most striking change was in tree form. Codominant trees now had an average Girard form class of 82.5 and dominants averaged 84.5. In terms of yearly change, the codominants increased in form class at the approximate rate of one percent of d.b.h. per year while the dominants gained at the rate of 0.76 percent per year.

Two items would seem to be of importance here. The change in form has been much more rapid than has usually been assumed, and a failure to recognize this in volume determinations would result in large errors. Secondly, the codominants have improved in form at a faster rate than the dominants so that by the end of the 15-year period there was relatively less difference in form between dominants and codominants. This variation in change of bole form results from the fact that ring width along the length of the bole is not uniform. For these dominant trees the growth at d.b.h. was faster than the diameter growth at 17.3 feet above ground, but the growth rate of the codominants at these two points was more nearly uniform. If inferences can be drawn from this limited study it would seem important to recognize separate form classes for different crown classes in stands up to about 35 years of age or some comparable stage of development in terms of height or diameter.

This plantation has been allowed to develop naturally over the years. No intermediate cuttings other than the removal of dead and dying understory trees and pruning of lower limbs had been performed. In 1950 the area was struck by a hurricane which did considerable damage to the plantations. The down timber was salvaged for pulpwood and, in addition, the operator did some row thinning to make the plantations accessible to vehicles. This work was done without the knowledge of the College of Forestry and no records were kept of volume removed. The only records the College has are the measurements in 1948 and 1958.

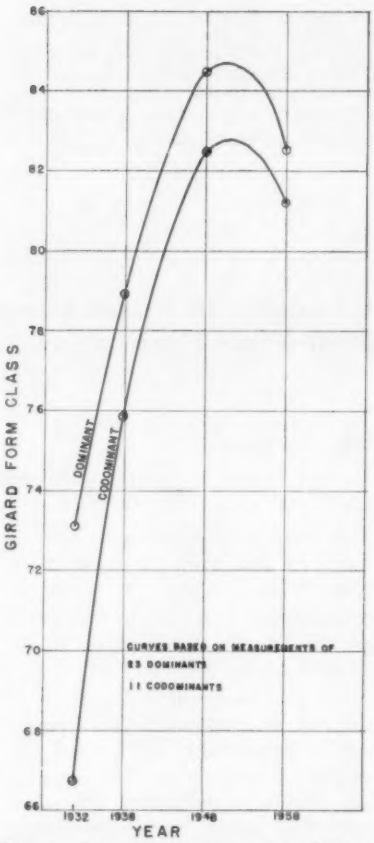


FIG. 1.—The relation of average Girard form class to year of measurement for study trees within red pine plantation at Great Bear Springs, N. Y.

From these figures, 194 square feet of basal area per acre in 1948 and 98 square feet basal area in 1958, it is estimated that 50 to 60 percent of the volume was removed due to the hurricane and subsequent thinning.

A thinning of this intensity had a pronounced effect on the form of the residual trees. Average Girard form class of the dominants dropped from an 84.5 in 1948 to 82.5 in 1958 and codominants dropped from an average of 82.5 to 81.2 during the same period. The residual stand was evidently adapting itself to its new environment and the shape of the boles has been altered to shift the center of gravity in response to the increased growing space. The shape of the curves (Fig. 1), between 1948 and 1958 is, of course, only an estimate of what has taken place. They indicate that the form class may drop still lower before the stand comes into balance with

[1]This condition of codominant trees having a lower Girard form class than dominant trees is unusual. Trees in the lower crown canopy generally taper less than the dominants. The comparative dimensions of the two crown classes may offer a possible explanation. Planted stands of red pine frequently show little differentiation into crown classes. At the present time there is only a 4.0 foot difference in average height and a 3.3 foot difference in average live crown length between the dominant and codominant trees in the stand under study. However, since 1932 the average d.b.h. of the dominant trees has been between 1.3 and 1.6 inches larger than the codominants. If it can be assumed that the codominant trees, because of their similarity in total height and live crown length, are subjected to approximately the same wind action as the dominants, it appears likely they would sway more because of a more slender bole. If this is the case, the codominants would be stimulated to produce proportionately more wood at d.b.h. and below than on the upper portions of the stem.

its surroundings, but this can be verified only by remeasurement at a later date.

If this small study is representative of conditions following a medium to heavy grade thinning, it points out an aspect of volume determination that has often been overlooked in thinning studies. This study indicates that volume estimates on thinned plots may be at least 4 percent lower than shown if the same Girard form class volume table were used to calculate volume on thinned and unthinned plots eight years after thinning.

A similar study by Bickerstaff[2] in Canada serves to strengthen two of these conclusions. The work involved the dominant elements of a red pine stand that was thinned at 18 years of age. Changes in bole form were measured by the formula

$$\frac{\text{Diameter (o.b.) at } \frac{1}{2} \text{ height above b.h.}}{\text{Diameter (o.b.) at b.h.}} \times 100$$

Five years later the form class of the thinned, unpruned stand had decreased 1.4 units while the unthinned, unpruned plot had increased in form by 1.9 units. If form was disregarded, the increase in volume attributable to thinning was 72 percent but when difference in form was recognized the increase was only 60 percent.

Conclusions

Although the above observations were drawn from a limited amount of data, the results are strong enough to warrant further investigations. It may not be too improbable to assume that the pattern of tree form development demonstrated here may be duplicated by coniferous plantations of similar stocking in other parts of the country. As plantation management is becoming increasingly important to forestry and wood-using industries, it is strongly urged that further studies be conducted in other regions to assess the relationship of tree form to age and crown position, and to measure the effect of thinning on Girard form class. Such studies are needed to properly measure volume growth of plantations and other aspects of volume determination.

[2]Bickerstaff, A. Effect of thinning and pruning upon the form of red pine. Canada Department of Mines and Resources, Lands, Parks and Forests Branch. Ottawa, Canada. Silv. Res. Note No. 81. pp. 22-24. 1946.

Syracuse Forestry College Host For Eastern Colleges Science Conference

College men and women majoring in science at 60 to 100 colleges and universities east of the Mississippi are expected to attend and participate in the Fifteenth Annual Eastern Colleges Science Conference to be held May 4-6, 1961, at the State University College of Forestry at Syracuse University.

Student chairman of the three-day conference is Robert A. Murphy, a senior majoring in forest chemistry at the College of Forestry.

Purpose of the 1961 Science Conference is to encourage undergraduate research by:

1. Providing a forum for the presentation of research papers by college undergraduates;

2. Offering undergraduates an opportunity to meet research scientists and hear them present papers; and

3. Programming educational field trips to places of scientific interest.

More than 100 papers will be delivered by college men and women at the conference.

College science majors do not have to give papers to participate in the conference. All interested undergraduates are eligible to attend.

Theme of the 1961 meeting is "The Inter-relation Between the Physical and Biological Sciences."

Fields of specialization to be represented at the meeting will include biology, chemistry, physics, mathematics, and the behavioral sciences.

Four of the eminent scientists who will address the conference are:

Drs. Frederick C. Steward, plant physiologist, and Howard A. Schneiderman, zoologist, Cornell University; Dr. C. Anfinsen, National Institutes of Health, Bethesda, Md., and Dr. Edwin W. Muller, physicist, Pennsylvania State University.

Last year's Annual Eastern Colleges Science Conference was held at Hunter College in New York City. The first meeting of the group was held at Vassar College.

The registration fee for the conference is $5 per person.

Faculty adviser for the conference is Dr. Ernest Sondheimer, associate professor of plant biochemistry at the College of Forestry.

Further information may be obtained by contacting Robert A. Murphy, Student Chairman, 15th Annual Eastern Colleges Science Conference, State University College of Forestry at Syracuse University, Syracuse 10, N. Y.

Development of Planted Loblolly Pine in a Poisoned Upland Hardwood Stand of the Lower Piedmont

William D. Miller

IN THE PAST fifteen years a great deal of effort has been expended on attempts to rid forest land of competing undesirable woody vegetation, using chemicals either alone or in combination with more drastic mechanical means. The literature is quite abundant on the initial success or failure of such endeavors, but rather meager on the aftermath or outcome.

This paper reports the nine-year results of a small study on chemical treatment of hardwoods in lower Piedmont soils, followed immediately after treatment by planting with 1-0 loblolly pine (*Pinus taeda* L.) nursery stock.

Method of Study

This experiment was initiated in the winter of 1949-1950 on the Hill Demonstration Forest, Durham County, North Carolina, with the objective of studying the effectiveness of basal spray and stump spray as methods of removing hardwoods one to three inches d.b.h. The two chemicals used were 2,4,5-T and Weedone, the latter a mixture of one-third 2,4,5-T and two-thirds 2,4-D. These were applied at three levels of concentration—one, two, and four percent acid equivalent by weight, using kerosene as a carrier. Check treatments included cutting without spraying, cutting and spraying stumps with kerosene, and basal spray with kerosene, Hardwoods larger than 3.5 inches d.b.h. were treated with Ammate in notches.

The area, from which pine had been harvested 17 years previously, was covered with moderately dense brush, consisting of approximately 3,200 stems per acre, one to three inches d.b.h. of the species composition shown below:

	Percent
Dogwood (*Cornus florida* L.)	60.3
Hickory (*Carya* spp.)	11.4
Red oak (*Quercus* spp.)	8.4
White Oak (*Quercus* spp.)	0.7
Miscellaneous[1]	19.2

Except for the high percentage of dogwood, the species composition was typical of the Hill Forest.

Sixty 1/40-acre subplots were laid out, providing four randomized replications of the twelve treatments and three checks.

Examination in October 1950 showed that the two methods of application gave practically equal percentage of kill. Effectiveness increased with concentration but did not increase at equal rates for the two chemicals. Pure 2,4,5-T reached 80 percent kill at 2 percent concentration; Weedone reached this degree of effectiveness only at 4 percent. There was little difference in percentage of kill between 2 percent 2,4,5-T and 4 percent Weedone, the values ranging from 80.2 to 82.8 percent.

Recognizing that the purpose of hardwood control is to promote the establishment of pine, the project was designed to include the planting of loblolly pine, and thus provide an answer to the question, "How much hardwood control is needed to establish pine?" One-year nursery-grown loblolly seedlings were planted in March 1950 at a spacing of $5\frac{1}{2} \times 5\frac{1}{2}$ feet, or 36 trees per fortieth-acre subplot. Of these trees, 11 were close enough to the plot boundaries to be subjected to border conditions; hence, only the 25 interior trees were included in subsequent observations and tallies of growth in height and diameter. The tallies of survival and vigor were based on all 36 trees.

Results

Survival and vigor.—At the end of the first growing season, October 1950, survival of the planted loblolly pine for all plots combined was 88 percent. There was a heavy infestation of tip moth at that time. and it was anticipated that the effects of this attack might contribute to an increase in mortality in the second season. This surmise

THE AUTHOR is associate professor of silviculture, School of Forestry, North Carolina State College, Raleigh.

Contribution from the Forest Research Department, North Carolina Agric. Expt. Sta., Raleigh. Published with the approval of the director of research as Paper No. 1088 of the Journal Series.

[1]This group includes red maple (*Acer rubrum* L.), black gum (*Nyssa sylvatica* Marsh.), sweet gum (*Liquidambar styraciflua* L.), black walnut (*Juglans nigra* L.), sourwood (*Oxydendron arboreum* DC), hawthorn (*Crataegus* spp.), yellow-poplar (*Liriodendron tulipifera* L.), redbud (*Cercis canadensis* L.), mulberry (*Morus* spp.), black cherry (*Prunus serotina* Ehrh.), and holly (*Ilex opaca* Ait.).

TABLE 1.—SURVIVAL TRENDS OF LOBLOLLY PINE OVER A 5-YEAR PERIOD, BY METHOD OF TREATMENT AND CHEMICAL. BASIS: 432 TREES PER INDIVIDUAL MEAN

Date	Cut surface		Basal spray		Average, all treatments	Check
	2,4,5-T	Weedone	2,4,5-T	Weedone		
	Percent					
June, 1953	71	74	68	63	69	56
June, 1955	67	70	65	59	65	48
June, 1957	66	67	64	57	63	45
May, 1958	62	65	62	54	61	41

TABLE 2.—NUMBER OF LOBLOLLY PINES PER ACRE, MAY 1958, BY VIGOR CLASSES

Vigor class	Cut surface		Basal spray		Average, all treatments	Check
	2,4,5-T	Weedone	2,4,5-T	Weedone		
	Number per acre					
Superior	497	487	433	330	437	173
Good	307	310	337	290	311	200
Fair	73	100	83	117	93	113
Poor	23	33	37	43	34	104
Total	900	930	890	780	875	590

was apparently correct. In the next three years, average survival of all treated plots dropped to 69 percent, and check plots down to 56 percent (Table 1). In the following five years, however, survival in the treated plots has remained almost constant, dropping only to 61 percent; further attrition in the check plots has continued at a rate twice as fast as that of the treated plots, and survival stood at 41 percent in May, 1958.

Thus, nine years after initial poisoning of the hardwoods and planting of the pine, the treated plots have an average of 875 living saplings per acre, in contrast to 590 on the check areas. The vigor classes of these trees are shown in Table 2.

The treated plots have 748 pines of superior or good vigor per acre as compared to 373 on the check plots, or a ratio of 2 to 1 in trees showing promise of future development. In number of fair and poor stems, this ratio is practically reversed.

Height growth.—The site index of the experimental area was determined by Coile's soil-site method, resulting in estimates of 77 feet for loblolly pine and 63 feet for shortleaf pine. Height-age determinations of site index were also made on a dozen merchantable shortleaf and Virginia pines around the plot borders, yielding estimates of 65 feet for shortleaf and 63 feet for Virginia pine.

In the light of this better than average site quality for these species in the Piedmont, the height growth of the plantation has been rather mediocre, even the best treatment averaging less than two feet per annum in the first nine years (Table 3). Several treatments, however, have attained a growth of two feet, or slightly better, in the year preceding the last remeasurement in May 1958.

The treated plots do not show as marked an advantage in height growth as in vigor classes. The average difference between pines of treated and untreated areas, although statistically significant at the 1 percent level, is only 2.9 feet, or 26 percent of the growth on the check plots. The modest size of this difference may be due to a combination of the following causes: The early tip moth injury, which would tend to be greater on the treated than on the shaded check plots; the tendency of young trees to divert a major portion of their growth energy into height growth; and the fact, repeatedly observed in this study, that loblolly pine is a strong competitor, often continuing to grow in height under a heavy blanket of vegetation.

The tallest loblolly pine was found on a plot in the CT series (cut brush, with stumps treated with 2,4,5-T); by May 1958 it was 25 feet in height. The shortest pine, found on a check plot, was 0.8 feet tall. Numerically, and consistently, the best average height growth of all planted loblolly has occurred in the CT-treated plots, but none of the differences between chemicals, methods of application, or concentration was statistically significant. Only the check plots differed significantly, unless a one in a hundred mischance had occurred in sampling.

Diameters.—The averages of d.b.h., basal area, and height growth are given in Table 4 for all pines which had reached breast height by the time of the 1958 remeasurement. The diameters of the treated trees averaged approximately twenty percent greater than those of the check plots. It was evident even on ocular inspection that trees on the check plots were more spindly than those on the treated areas. Again, as in height development, there were no significant differences between the various methods of treatment, chemicals, and concentrations. The largest individual diameter, however, was measured on a CT plot on the same tree which attained the greatest height in the plantation. The diameter of this tree was 4.3 inches, the height 25 feet.

Basal area.—The spindly condition of the check plot trees is more clearly demonstrated by comparing the basal areas. By the ninth season after planting, the treated plots averaged 2.69 times greater basal area per acre than did the check plots (Table 4). This advantage is the result of differences in squared diameter and in number of pines per acre. If we multiply the basal areas by the height to obtain approximate indexes of volume production, the treated plots have a 3-to-1 superiority. It is almost certain that this margin will widen as time goes on.

Resurgence of hardwoods.—Poisoning as used in this experiment did not result in complete elimination of hardwoods, as might be obvious. The reduction, however, was substantial, and even by the sixth growing season, the resurgence of new hardwood competition in the 1-to-3 inch d.b.h. classes was still only about one-third of that found on the check plots (Table 5). Smaller hardwoods (from one foot high up to 0.5 inch in d.b.h.) were actually greater in number by a ratio of 1.31 on the treated plots than on the check plots, but this size class was too far behind to offer serious competition to the main stand of the planted loblolly, except as it may eventually help to eliminate the pine on the check plots.

Pine volunteers.—Actually, the pine stocking on the treated plots is better than is suggested by the

TABLE 3.—AVERAGE HEIGHT OF LOBLOLLY PINE, BY METHOD OF TREATMENT AND CHEMICAL. BASIS: 300 TREES PER INDIVIDUAL MEAN

Date	Cut surface		Basal spray		Average, all treatments	Check
	2,4,5-T Weedone		2,4,5-T Weedone			
	Feet					
June, 1953	4.4	3.9	3.5	4.1	4.0	3.1
June, 1955	8.0	7.0	6.5	7.1	7.1	5.6
June, 1957	13.4	11.8	11.1	11.6	12.0	9.3
May, 1958	15.6	13.8	12.9	13.4	13.9	11.0

TABLE 4.—AVERAGE GROWTH DATA FOR LOBLOLLY PINES 4.5 FEET OR MORE IN HEIGHT, MAY 1958

Measurement	Cut surface		Basal spray		Average, all treatments	Check
	2,4,5-T Weedone		2,4,5-T Weedone			
D.b.h. inches	2.2	1.9	1.8	1.9	1.9	1.6
Basal area per acre, sq. ft.	14.80	11.48	10.68	10.19	11.79	4.38
Height, ft.	15.6	14.0	13.3	14.0	14.2	12.2

TABLE 5.—REGROWTH OF HARDWOODS ON TREATED PLOTS IN RELATION TO HARDWOODS ON CHECK PLOTS

Size class	Cut surface		Basal spray		Average, all treatments	Check
	2,4,5-T	Weedone	2,4,5-T	Weedone		
1-3 Inches, d.b.h.						
Basal area, sq. ft. per acre	2.11	2.21	2.24	6.49	3.26	10.19
Number of stems per acre	343	503	200	467	328	905
1 Foot to 0.5 in. d.b.h.						
Number of stems per acre	1,923	1,753	1,303	1,417	1,599	1,217

TABLE 6.—VOLUNTEER VIRGINIA PINE SEEDLINGS PER ACRE IN THE SIXTH GROWING SEASON, JULY 1955, AFTER TREATMENT

Height class	All treated plots	Check plots
Feet	*No.*	*No.*
0 - 0.5	104	—
0.6 - 1.0	167	83
1.1 - 2.0	562	—
2.1 - 3.0	312	250
3.1 up	500	83
Total, all heights	1,645	416

data in Table 1. Virginia pine volunteers have become established in large numbers by natural seeding from parent trees along the southwest and northeast margins of the experimental area. Before the chemical treatments in the winter of 1950, there were no pine seedlings on the area. By 1955 there were 500 Virginia pines 3 feet and taller per acre on the treated plots, some of them comparable to the loblolly pine in size (Table 6).

Virginia pine has volunteered into the check plots also, but their development is much weaker, and in number of larger seedlings, the ratio of treated over the checks stands 6 to 1.

Discussion

The great majority of the subplots in this experiment are now adequately stocked with pine which has attained dominance partly because of the chemical treatments but also because of the competitive ability of loblolly. The established pine is now in a position to develop into a well-stocked merchantable stand without assistance by hand weeding.

Although material and labor costs were kept for each plot, the small size of the plots does not provide a realistic basis for an economic appraisal of the operation. Nevertheless, it is interesting to note what the actual expenditures were in using treatments that met the minimum objective of 80 percent kill at the end of the first season. Two percent 2,4,5-T proved to be the cheapest chemical meeting this standard; it cost $20.84 for basal spraying, $36.27 for stump spraying, both costs expanded to an acre basis. The difference in costs here is almost entirely due to the greater labor involved in felling.

Some additional expense was incurred on the project because of partial failure of the ammate treatment to kill the larger trees. A substantial number of hardwoods continued to live after the original ammating in February 1950. A possible cause of this failure is the fact that the ammate was applied in the dormant season. In the summer of 1953 a class of forestry students ammated the living hardwoods, but their success was only partial because of inadequate notching. In June 1958 this operation was repeated, and a bark girdle was also made on each tree.

This paper does not provide economic justification for the poisoning of hardwoods, but merely describes the physical development attained by the planted pine in the ninth growing season after poisoning of the original hardwood stand. Some landowners would not hesitate to make the expenditures indicated here if they were assured of similar success in establishing pine. Many owners, however, would not care to make such a large initial investment. It will be necessary to reduce costs before these methods will find wider acceptance, particularly among the smaller class of owners. Research toward this objective is now in progress, and some of it looks promising. For example, Hough and Huntzinger (*5*) report obtaining a high percentage of kill with 2,4,5-T dosages of only 0.15 to 0.30 percent applied to root collars of small stumps.

Summary

A replicated and randomized poisoning and planting experiment on the Hill Demonstration Forest, Durham County, North Carolina, with two formulations of phenoxyacetic acid, three concentrations, and two methods of application has resulted, in nine growing seasons, in the conversion of a moderately dense upland hardwood stand to an established loblolly pine stand of 875 stems per acre.

1. Basal area provided the most striking contrast between the development of loblolly on treated plots and that on check plots.

2. Treated plots had only one-third as many hardwood stems in the 1-to-3-inch d.b.h. class as were found on check plots, but a substantially greater number of hardwoods ½-inch d.b.h. and smaller. Despite the abundance of hardwood regrowth, pine was clearly dominant.

3. Pines in vigorous condition were twice as numerous on the treated as on the check plots.

4. Volume production indexes showed a 3-to-1 ratio in favor of the treated plots.

Literature Cited

1. BARBER, J. C. 1951. The Control of various species of hardwood brush with 2,4-D and 2,4,5-T applied to freshly-cut stumps during the dormant season. M.A. thesis, North Carolina State College.
2. ————.1952. Basal spray or stump spray? Jour. Forestry 50: 690-691.
3. COILE, T. S. 1948. Relation of soil characteristics to site index of loblolly and shortleaf pines in the lower Piedmont region of North Carolina. Duke University School of Forestry. Bulletin 13.
4. DELLINGER, H. C. 1951. Bark application of silvicides in hardwood control. M.A. thesis, North Carolina State College.
5. HOUGH, A. F., and H. J. HUNTZINGER, 1958. A test of measured dosages for chemical control of Allegheny hardwoods. U. S. Forest Service, Northeastern Forest Expt. Sta. Station Paper 104.

Loblolly Pine Seed Production in the Virginia-North Carolina Coastal Plain

Peter H. Allen and
Kenneth B. Trousdell

KNOWLEDGE of seed production in managed forest stands is essential before natural regeneration may be obtained consistently. This report is a summary of the seed-trapping data obtained during the study of natural regeneration of loblolly pine in the Bigwoods and Camp Experimental Forests.[1] Compartment records of seedfall were obtained during a thirteen-year period (1946-1947 through 1958-1959), and continuous records within a compartment extend for up to ten years.

Trapping Techniques

Square, ¼-milacre seed traps were constructed of wood, with fly screen bottoms and hinged tops of ¾-inch mesh wire or chicken wire. The traps were set about one foot above the ground.

Nine traps, located by a stratified random design, were used per 35- to 40-acre compartment in the Bigwoods. On each ninth of a compartment a trap was placed in the center of one of nine equal subdivisions, chosen randomly. Traps in the Camp Experimental Forest were placed in 10 separate one-chain-square blocks, chosen randomly.

Traps were checked at monthly intervals, from early November through early April. The seeds were counted, and the number of sound seeds was determined by cutting tests.

Seasonal Distribution

Seed began to fall in October, and 71 percent of the seeds collected in uncut stands had fallen by the end of November. After the November peak the rate of seedfall decreased with time, and some seeds were still falling in March. This time of seedfall agrees with that described by Pomeroy and Korstian (*5*).

After initial opening, loblolly pine cones tend to close in wet weather, restricting seedfall until they dry out and reopen. The improved air circulation after partial stand removal might be expected to hasten cone drying and seedfall, but an analysis of the data indicates this effect is slight. In open stands of four and eight seed trees per acre, only 3 percent more of the total seedfall was collected by the end of November than in uncut stands.

Annual Variation

Data obtained in this study indicate considerable annual fluctuation in seed crop size. The amount of sound seed produced per acre in three uncut compartments is shown in Figure 1. The annual trend of crop size was similar in compartments located within 30 miles of each other. In a 55- to 60-year-old stand in Sussex County, Virginia, 50,000 or more sound seed per acre fell in four out of

THE AUTHORS are with the Southeastern Forest Expt. Sta., Forest Service, U. S. Dept. Agric., Asheville, N. C.

[1]Located in northeastern North Carolina and southeastern Virginia, respectively. Maintained by the Southeastern Forest Expt. Sta. in cooperation with the Union Bag-Camp Paper Corporation, Franklin, Va.

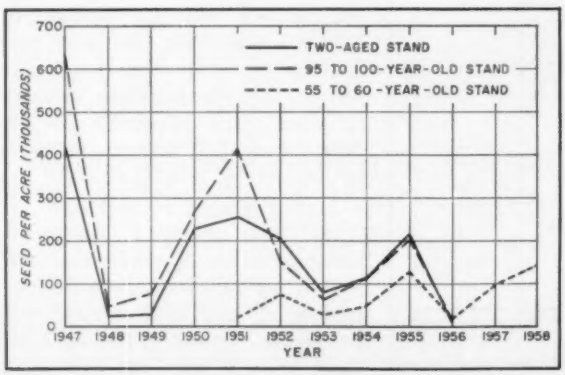


FIG. 1.—Sound seed production in uncut mature loblolly pine stands.

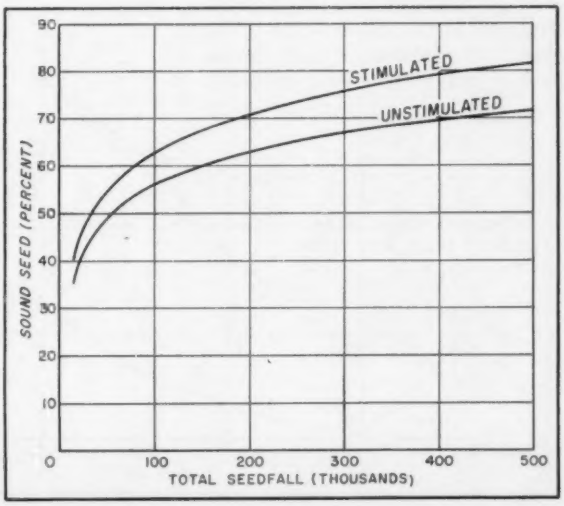


FIG. 2.—Relationship of soundness with seed crop size and effect of stimulation by release.

eight years of trapping. This level of production occurred in eight out of ten years in a 95- to 100-year-old stand of old-field origin, and in seven out of ten years in a two-aged stand composed of 60- to 80- and over 100-year old forest grown trees.

All compartments trapped failed to produce appreciable seed crops in 1956, after severe, regionwide frosts during the last five days of March 1955 had damaged the flowers just before pollen was released.

Other reports of loblolly pine seed production mention considerable annual variation in crop size. Lotti (*3*) found consistently good crops in a thinned 35- to 45-year-old stand in the South Carolina coastal plain. Annual production was more than 200,000 sound seed per acre in nine out of ten years of measurement. Similar large crops of seed were reported for two nearly 50-year-old stands (*4*). In other areas, however, smaller crops and less consistent production have been reported. In a 70-year-old stand in the Duke Forest in the North Carolina piedmont, 50,000 or more seed fell in 8 out of 13 years (*5*). In the Georgia piedmont Brender (*1*) recorded seed crops of this size in 7 out of 10 years in an adequately stocked mature stand.

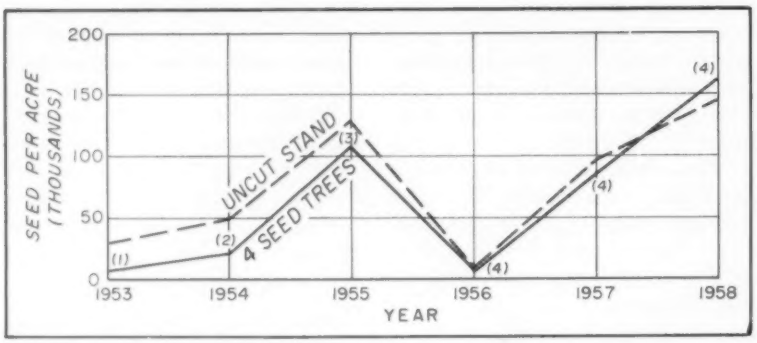


FIG. 3.—Average sound seed production in 55- to 60-year-old stands of 4 stimulated seed trees per acre as compared with uncut stand. Number of compartments sampled is shown for each year.

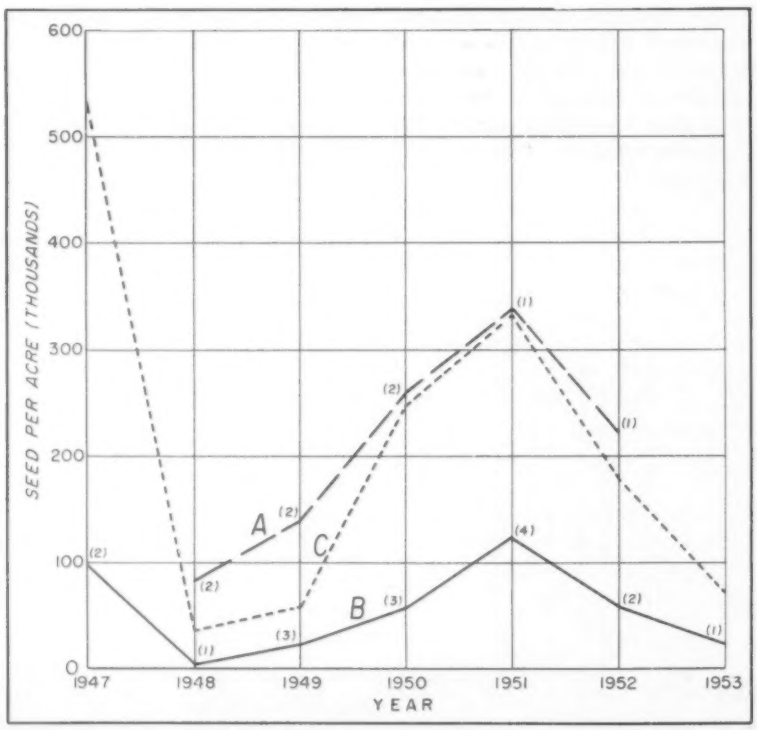


FIG. 4.—Average production of sound seeds in mature stands cut to strips and 8 seed trees (A-stimulated by release; B-unstimulated), compared with uncut stands of the same age (C). Number of compartments sampled is shown for each year.

Stimulation by Release

Frequently success of the residual seed source is dependent upon stimulation by preharvest release (*6*). Removal of adjacent trees before flower buds are initiated increases the number of buds formed and the seeds produced three, four, and five cone crops later. Our results indicate stimulated trees invariably produce larger seed crops. This effect is most important in poor seed years, such as 1948, 1949, and 1953, when unreleased stands did not produce sufficient seed for regeneration on unprepared seedbeds. Even released stands are unsatisfactory seed producers in years such as 1956 after unseasonable weather damaged the developing flowers.

Not only does release increase seed production, but it also improves the proportion of sound seed. An analysis of 96 compartment-sized measurements of the annual seed crop showed a highly significant relationship of percentage of sound seed with both size of crop and the added effect of release (Fig. 2). That soundness is improved by release had not previously been recognized (*6*). Pomeroy and Korstian demonstrated that the proportion of sound seed increases with the size of the seed crop. Although it has been shown that the relationship between seed crop size and percentage of sound seed is a linear one (*6, 7*), the inclusion of more data has made its logarithmic nature apparent. It may be expressed as:

$Y = .10067971 + .24593228x_1 - .01829624x_2$, where Y represents the proportion of sound seeds expressed as a decimal, x_1 is the logarithm of the total seedfall expressed in thousands, and x_2 is defined as: $+ x_1$ when not stimulated by release and $-x_1$ when stimulated.

Production in Managed Stands

Since well-stocked stands in the coastal plain frequently produce ample crops of seed, winter clearcutting after seedfall, but prior to germination, is practiced by some foresters. Cone crop forecasting permits preliminary planning, but there is no present way to predict unseasonable weather during the critical first year of regeneration. Insurance against unusual seed and seedling mortality is often provided by leaving some part of the stand until regeneration is established.

To evaluate the success of residual seed sources, seeds were trapped in mature stands clearcut to four and eight seed trees per acre and to chainwide strips spaced 4-chains apart. The average production in these stands is shown in Figures 3 and 4. Production after each type of cutting is compared with that in similar uncut stands. The magnitude of seed crops in individual stands varied, particularly in good seed years, but the production in all stands trapped reflected the yearly trends.

Data obtained in the North Carolina coastal plain indicate that roughly 50,000 or 60,000 sound seed per acre are needed the first seedfall after logging to obtain satisfactory regeneration without seedbed preparation.[2] Disking prior to logging, or burning after logging, reduced the requirement to about 20,000 to 30,000 sound seed per acre.

The 55- to 60-year-old stands clearcut to four stimulated seed trees per acre (Fig. 3) produced about as many seed as an uncut stand of the same age, but in three out of six years this supply would not have been satisfactory on unprepared sites. These trees received their first release three growing seasons prior to cutting and were apparently re-stimulated by the harvest cut.

No appreciable difference between seed production in stands clearcut to strips and those cut to eight seed trees was observed and they are not separated in Figure 4. The stimulated, residual trees frequently produced as much or more seed than the fully-stocked uncut stands. Over 50,000 sound seeds per acre were produced every year of the trapping. The difference between stimulated and unstimulated stands is quite apparent in Figure 4.

[2]Unpublished data, Southeastern Forest Expt. Sta.

Seed production was also measured in partially cut stands. Figure 5 shows seed production in two mature stands after two periodic cuts under the selection system. Compartment 8, cut in May 1947 and again in the winter of 1952-1953, had stimulated seed production in 1949-1951 and 1954-1956. Stimulation in compartment 18 was apparent in 1950, following the first cut in the fall of 1947, and continued until 1952. The second cut and period of stimulation were the same as in compartment 8.

Size of seed trees is an important factor affecting seed production and is in turn related to the age and density of the stand. Opengrown trees, even at fairly young ages, produce good seed crops, but in well-stocked unmanaged stands significant cone production does not begin until the trees are from 30 to 50 years old. The older stands in this study generally provided good seed crops which could not be expected in young unmanaged stands. Stimulation by thinning, however, or other preharvest release, considerably increases seed production in young stands. In young loblolly pine plantations in Australia, Florence and McWilliam (*2*) found increased pollen and cone production at lower stand densities.

Stimulation by thinning was apparent in a 30- to 35-year-old stand (Fig. 6). In this stand there were very few cones prior to thinning in 1950, but these immature trees produced fairly sizable seed crops after stimulation. Even larger crops were reported by Lotti (*3*) in a

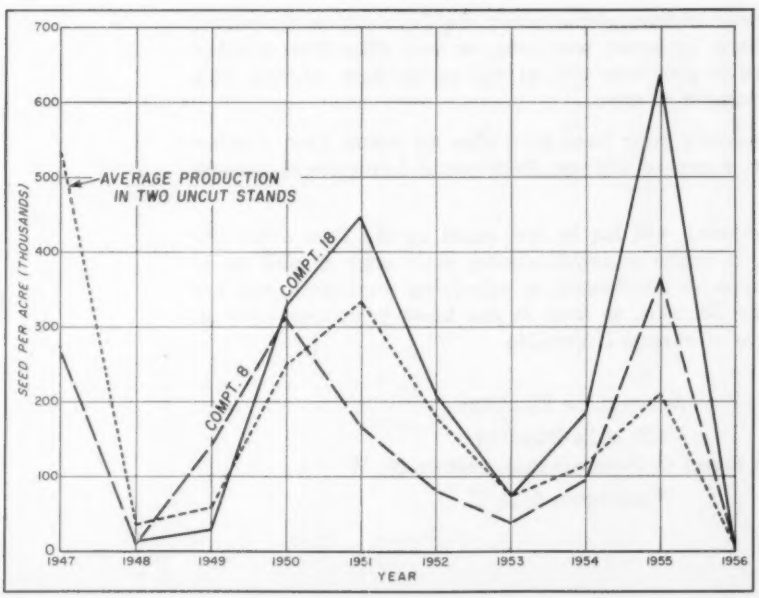


FIG. 5.—Sound seed production in mature selectively cut stands. Compartment 8 was partially cut May 1947 and December 1952; compartment 18 in October 1947 and January 1953.

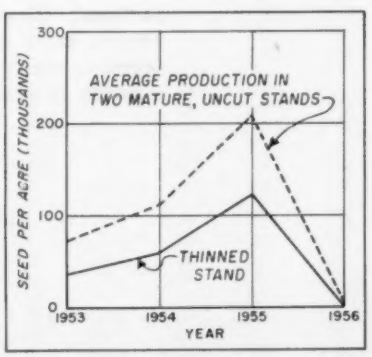


FIG. 6.—Sound seed production in a 30- to 35-year-old thinned stand compared with mature, uncut stands.

young thinned stand in the South Carolina coastal plain.

Summary

Thirteen-year seed-trapping records, obtained during the study of the natural regeneration of loblolly pine, have been used to evaluate seed production under different types of management.

Seed crop size fluctuated considerably from year to year in both uncut and partially cut stands. Almost invariably, stands within 30 miles of each other followed the same annual trend of seed production.

Stimulation by preharvest release of the seed source improved production, particularly in the poor seed years. Stimulated, selectively cut stands of mature trees produced more seed than uncut stands of a similar age. Stimulated strips and eight seed trees per acre produced quantities similar to uncut stands, and provided an ample seed source. Four mature seed trees per acre, stimulated by preharvest release, produced about as much as an uncut stand of the same age, but in some years this supply was inadequate. In poor years unstimulated seed sources generally did not provide sufficient seed for regeneration on unprepared sites.

Not only does release improve seed production, but it also produces a highly significant increase in the percentage of sound seed.

Stand age and density are important factors affecting seed production. Young forest-grown trees are generally unsatisfactory seed producers, unless stimulated by thinning or other preharvest release.

Literature Cited

1. BRENDER, E. V. 1958. A 10-year record of pine seed production on the Hitchiti Experimental Forest. Jour. Forestry 56:408-410.
2. FLORENCE, R. G., and J. R. MCWILLIAM. 1956. The influence of spacing on seed production. Zeitschrift für Furstgenetik und Forstpflanzenzüchtung 5(4):97-102.
3. LOTTI, THOMAS. 1956. Good seed production from a young stand of loblolly pine. U. S. Forest Service, Southeastern Forest Expt. Sta. Res. Note 97.
4. ————, and W. P. LEGRANDE. 1959. Loblolly pine seed production and seedling crops in the lower coastal plain of South Carolina. Jour. Forestry 57:580-581.
5. POMEROY, K. B., and C. F. KORSTIAN. 1949. Further results on loblolly pine seed production and dispersal. Jour. Forestry 47:968-970.
6. WENGER, KARL F. 1954. The stimulation of loblolly pine seed trees by preharvest release. Jour. Forestry 52:115-118.
7. ————, and KENNETH B. TROUSDELL. 1958. Natural regeneration of loblolly pine in the South Atlantic Coastal Plain. U. S. Dept. Agric. Prod. Res. Report 13.

Important Notice to Subscribers

If you change your address please notify the JOURNAL OF FORESTRY, preferably in advance, by letter, post card, or post office form number POD 3573. Be sure to give your old, as well as the new, address with your postal zone number if any.

You should also notify your local post office on postal form number POD 3575 of your change of address. Both postal forms are obtainable at any post office.

Copies of the JOURNAL will not be forwarded by the Post Office Department. Hence, in order to avoid missing your copy as well as to prevent extra expense to the Society in supplying duplicates, you are urged to notify the JOURNAL as soon as you know your new address, a month in advance of change if possible.

JOURNAL OF FORESTRY
425 Mills Building
17th Street at Pennsylvania Avenue, N. W.
Washington 6, D. C.

A Simplified Method of Computing Cordwood Volumes in the Woods

Jim E. Dale

FREQUENTLY the practicing forester is faced with the problem of estimating the cordwood volume of individual trees, or stands of trees, in the woods without the aid of volume tables, basal area factors, or other means of converting the easily obtained measurements of height and diameter breast height into cords, the standard unit of measure in commerce.

When he is faced with this problem, the practicing forester or woodsman usually bases his estimation on personal experience and judgment. He generally considers two things in arriving at his estimate of the volume in standard cords:

1. The average size of the trees and the number of trees he thinks it will take to make a truckload of pulpwood.

2. The number of cords of wood that he has learned it takes to make a truckload.

If the estimator wants to know the number of trees per cord, he mentally divides the number of trees he thinks it will take to make

TABLE 1.—COMPARISON OF BASAL AREA AND SUMMATION FACTOR OF TREES FROM 2 INCHES TO 20 INCHES D.B.H.

D.b.h.	Basal area	Summation factor
Inches	*Sq. ft.*	
2	0.02	0.02
3	.05	.05
4	.09	.09
5	.14	.14
6	.20	.20
7	.27	.27
8	.35	.35
9	.44	.44
10	.54	.54
11	.66	.65
12	.78	.77
13	.92	.90
14	1.07	1.04
15	1.23	1.19
16	1.40	1.35
17	1.58	1.52
18	1.77	1.70
19	1.97	1.89
20	2.18	2.09

THE AUTHOR is division forester, W. M. Ritter Lumber Co., Hallsboro, N. C.

VOLUME TABLE 1.—WHITE PINE IN CORDS.[1] (CORDS BY THE SUMMATION METHOD IN PARENTHESES.)

	Total height of tree—feet						
D.b.h.	30	40	50	60	70	80	90
Inches							
5	.03 (.02)	—	—	—	—	—	—
6	.03 (.03)	.04 (.04)	.05 (.05)	—	—	—	—
7	.04 (.04)	.05 (.05)	.07 (.07)	.09 (.08)	—	—	—
8	.05 (.05)	.07 (.07)	.09 (.09)	.11 (.10)	.13 (.12)	—	—
9	.07 (.07)	.09 (.09)	.11 (.11)	.13 (.13)	.16 (.15)	—	—
10	—	.11 (.11)	.13 (.13)	.16 (.16)	.19 (.19)	.22 (.22)	
11	—	.13 (.13)	.16 (.16)	.19 (.19)	.23 (.23)	.26 (.26)	.30 (.29)
12	—	.15 (.15)	.19 (.19)	.22 (.23)	.27 (.27)	.31 (.31)	.35 (.35)
13	—	.17 (.18)	.22 (.22)	.26 (.27)	.31 (.31)	.36 (.36)	.40 (.40)
14	—	—	.25 (.26)	.30 (.31)	.34 (.36)	.41 (.42)	.45 (.47)
15	—	—	.28 (.30)	.34 (.36)	.40 (.42)	.46 (.48)	.51 (.54)

[1] Cary, Austin. Woodsman's manual. The Harvard University Press. 1939. Includes volume of tree above ½ foot from ground and up to 4 inches diameter in the top. (From State Forester of Massachusetts.)

VOLUME TABLE 2.—SPRUCE IN CORDS OF ROUGH WOOD.[1] (CORDS BY THE SUMMATION METHOD IN PARENTHESES.)

	Total height of tree—feet								
D.b.h.	40	45	50	55	60	65	70	75	80
Inches									
6	.04 (.04)	.04 (.04)	.05 (.05)	.06 (.05)	—	—	—	—	—
7	.06 (.05)	.06 (.06)	.07 (.07)	.08 (.07)	.09 (.08)	—	—	—	—
8	.07 (.07)	.08 (.08)	.09 (.09)	.10 (.10)	.12 (.10)	.13 (.12)	—	—	—
9	.09 (.09)	.10 (.10)	.12 (.11)	.13 (.12)	.14 (.13)	.16 (.14)	—	—	—
10	.11 (.11)	.12 (.12)	.14 (.13)	.16 (.15)	.17 (.16)	.19 (.18)	.20 (.19)	.22 (.20)	—
11	—	.15 (.15)	.17 (.16)	.19 (.18)	.20 (.19)	.22 (.21)	.24 (.23)	.26 (.24)	.28 (.26)
12	—	.18 (.17)	.20 (.19)	.22 (.21)	.24 (.23)	.26 (.25)	.28 (.27)	.30 (.29)	.32 (.31)
13	—	.21 (.20)	.23 (.22)	.25 (.25)	.27 (.27)	.30 (.29)	.32 (.31)	.34 (.34)	.37 (.36)
14	—	—	.26 (.26)	.29 (.29)	.31 (.31)	.34 (.34)	.36 (.36)	.39 (.39)	.42 (.42)
15	—	—	—	.32 (.33)	.35 (.36)	.38 (.39)	.40 (.42)	.43 (.45)	.47 (.48)
16	—	—	—	.36 (.37)	.39 (.40)	.42 (.44)	.45 (.47)	.48 (.51)	.52 (.54)
17	—	—	—	.40 (.42)	.43 (.46)	.46 (.49)	.50 (.53)	.54 (.57)	.59 (.61)
18	—	—	—	.45 (.47)	.48 (.51)	.50 (.54)	.55 (.59)	.59 (.64)	.64 (.68)
19	—	—	—	.49 (.49)	.52 (.54)	.56 (.58)	.60 (.63)	.65 (.67)	.70 (.72)
20	—	—	—	.52 (.55)	.57 (.60)	.62 (.65)	.66 (.70)	.72 (.75)	.77 (.80)

[1] Cary, Austin. Woodsman's manual. The Harvard University Press. 1939. Based on 2,500 trees cut in Maine, New Hampshire, and New York; 4 inches top.

VOLUME TABLE 3.—NEW ENGLAND HARDWOODS IN CORDS.[1] (CORDS BY THE SUMMATION METHOD IN PARENTHESES.)

	Total height of tree—feet						
D.b.h.	20	30	40	50	60	70	80
Inches							
3	.009	.01?	.015	.018	—	—	—
	(.005)	(.01)	(.01)	(.01)			
4	.015	.019	.024	.029	—	—	—
	(.01)	(.01)	(.02)	(.02)			
5	—	.031	.034	.043	.051	—	—
		(.02)	(.03)	(.04)	(.04)	—	—
6	—	—	.048	.060	.072	.081	—
			(.04)	(.05)	(.06)	(.07)	
7	—	—	.063	.079	.095	.113	—
			(.05)	(.07)	(.08)	(.09)	
8	—	—	.078	.101	.122	.140	.153
			(.07)	(.09)	(.10)	(.12)	(.14)
9	—	—	.095	.125	.149	.168	.184
			(.09)	(.11)	(.13)	(.15)	(.18)
10	—	—	—	.151	.179	.199	.217
				(.13)	(.16)	(.19)	(.22)
11	—	—	—	.179	.212	.235	.252
				(.16)	(.19)	(.23)	(.26)
12	—	—	—	.210	.251	.276	.294
				(.19)	(.23)	(.27)	(.31)
13	—	—	—	.246	.292	.324	.343
				(.22)	(.27)	(.31)	(.36)
14	—	—	—	.286	.338	.374	.392
				(.26)	(.31)	(.36)	(.42)
15	—	—	—	.332	.390	.430	.450
				(.30)	(.36)	(.42)	(.48)
16	—	—	—	.383	.451	.491	.565
				(.34)	(.40)	(.47)	(.54)

[1]Cary, Austin. Woodsman's manual. The Harvard University Press. 1939.
Table produced on Harvard Forest. Worked out for red maple but holds for other species. Wood used for fuel down to a diameter of 2 inches.

VOLUME TABLE 4.—JACK PINE IN CORDS.[1] (CORDS BY THE SUMMATION METHOD IN PARENTHESES.)

	Total height of tree—feet					
	40	50	60	70	80	90
D.b.h.	Volume in cords					
Inches						
5	.03	.04	.04	—	—	—
	(.03)	(.03)	(.04)			
6	.04	.05	.06	—	—	—
	(.04)	(.05)	(.06)			
7	.05	.06	.08	.09	—	—
	(.05)	(.07)	(.08)	(.09)		
8	.07	.08	.10	.12	—	—
	(.07)	(.09)	(.10)	(.12)		
9	.08	.10	.12	.14	.16	—
	(.09)	(.11)	(.13)	(.15)	(.18)	
10	—	.12	.15	.17	.20	—
		(.13)	(.16)	(.19)	(.22)	
11	—	.14	.17	.21	.23	.27
		(.16)	(.19)	(.23)	(.26)	(.29)
12	—	—	.21	.24	.27	.31
			(.23)	(.27)	(.31)	(.35)
13	—	—	.24	.28	.32	.36
			(.27)	(.31)	(.36)	(.40)
14	—	—	.28	.32	.37	.41
			(.31)	(.36)	(.42)	(.47)
15	—	—	.31	.36	.41	.47
			(.36)	(.42)	(.48)	(.54)
16	—	—	.35	.41	.47	.53
			(.40)	(.47)	(.54)	(.61)

[1]Cary, Austin. Woodsman's manual. The Harvard University Press. 1939.
Volume of stems, bark on, between stump one foot high and three inches top diameter. (From the Lake States Forest Experiment Station.)

a truckload by the number of cords in his imaginary truckload. If he wants to know the number of cords per acre, he tries to visualize the number of truckloads he can cut per acre, or he divides the number of trees per acre by the number of trees per cord.

A fairly precise method for estimating the cordwood content of individual trees has been devised by the author based on an observation that the basal area of a tree at d.b.h. can be approximated by a simple summation:

$$\text{Basal area} = \frac{\text{summation of } 2''+3''+4''+\ldots.+\text{d.b.h.}}{100}$$

Thus, for a tree 8 inches in diameter at breast height the summation factor equals

$$\frac{2''+3''+4''+5''+6''+7''+8''}{100} \text{ or } 0.35$$

Table 1 shows the comparison between basal areas and the summation factors computed for trees from 2 inches to 20 inches d.b.h.

The summation factors are easy to determine at any time they are needed. The cordwood content of an individual tree can be estimated with the following equation:

$$\text{Cords} = \frac{\text{Summation factor} \times \text{total height} \times 5}{1{,}000}$$

As an example, suppose the 8 inch tree, whose summation factor was found to be 0.35, has a total height of 55 feet.

Then,

$$\text{Cords} = \frac{0.35 \times 55' \times 5}{1{,}000} = \frac{96.25}{1{,}000} = 0.096 \text{ or } 0.10$$

Thus a tree having a d.b.h. of 8 inches and a height of 55 feet would be expected to yield 0.10 cord of stacked wood.

A tabulated comparison of volumes computed by the author's summation method with volumes actually measured from prepared cordwood trees can be easily seen in Volume Tables 1 to 4, published by Cary (1939) and in Volume Table 5 published by Slocum and Miller (1953). The volume tables apply to a variety of species of conifers and hardwoods native to eastern United States.

It should be pointed out that the volume tables selected to illustrate the summation method of calculating cordwood volumes were prepared by different workers in different areas and noted that there is a difference in the degree of utilization practiced, and possibly other factors affecting yield. Nevertheless, the yields are quite close for the various species at each diameter and height class. The

volumes calculated by summation are also quite close; however, the greatest difference is noted in Volume Table 3, New England hardwoods, which was prepared for fuelwood down to a minimum 2 inch diameter, and in Volume Table 4, jack pine, which was cut to a stump height of 1 foot. Probably the actual cordwood produced from New England hardwoods and jack pine would have been closer to the volume calculated by summation if the utilization practiced had been more nearly like that practiced in pulpwood operations today.

The volumes calculated by summation appear to be sufficiently accurate to justify their use in rough field approximations of the cordwood contents of individual trees and groups of trees, since the estimator does not have to refer to published statistics or basal area tables to arrive at his approximation, nor is it necessary to fell the tree to obtain the data needed for the calculation of volumes.

VOLUME TABLE 5.—MECHANTABLE VOLUME IN STANDARD CORDS OUTSIDE BARK FOR INDIVIDUAL TREES, *Pinus virginiana*[1]
(CORDS BY SUMMATION METHOD IN PARENTHESES)

D.b.h.	Total height—feet								Number trees
	20	30	40	50	60	70	80	90	
Inches									
4	.008	.013	.020	.027	.031	—	—	—	2
	(.01)	(.01)	(.02)	(.02)	(.03)				
5	.012	.019	.027	.037	.044	—	—	—	19
	(.01)	(.02)	(.03)	(.03)	(.04)				
6	.021	.031	.043	.054	.064	.074	—	—	31
	(.02)	(.03)	(.04)	(.05)	(.06)	(.07)			
7	—	.040	.054	.068	.084	.100	.114	—	48
		(.04)	(.05)	(.07)	(.08)	(.09)	(.11)		
8	—	.056	.074	.091	.109	.127	.144	.162	55
		(.05)	(.07)	(.09)	(.10)	(.12)	(.14)	(.16)	
9	—	.071	.093	.115	.138	.161	1.84	.205	97
		(.07)	(.09)	(.11)	(.13)	(.15)	(.18)	(.20)	
10	—	.083	.113	.140	.170	.197	.225	.254	95
		(.08)	(.11)	(.13)	(.16)	(.19)	(.22)	(.24)	
11	—	—	.135	.171	.204	.240	.272	.307	84
			(.13)	(.16)	(.19)	(.23)	(.26)	(.29)	
12	—	—	.158	.198	.241	.280	.321	.360	63
			(.15)	(.19)	(.23)	(.27)	(.31)	(.35)	
13	—	—	—	.237	.281	.333	.378	.425	55
				(.22)	(.27)	(.31)	(.36)	(.40)	
14	—	—	—	.275	.333	.386	.441	.496	42
				(.26)	(.31)	(.36)	(.42)	(.47)	
15	—	—	—	.312	.374	.437	.498	.562	18
				(.30)	(.36)	(.42)	(.48)	(.54)	
17	—	—	—	—	.428	.498	.568	.640	8
					(.40)	(.47)	(.54)	(.61)	
16	—	—	—	—	.477	.555	.635	.711	2
					(.46)	(.53)	(.61)	(.68)	
18	—	—	—	—	.535	.625	.714	.802	3
					(.51)	(.59)	(.68)	(.76)	
Trees		11	37	53	89	201	231		622

[1]Slocum, G. K., and W. D. Miller. Virginia pine. North Carolina Agric. Expt. Sta. Tech. Bul. No. 100. 1953.

Introductions needed? Not if you (1) possess a television set and (2) have a youngster in the house. For the information of others this is June Lockhart and Timmy of the TV series "Lassie." The USFS reports that the filmed Lassie television program will release a "forest ranger" show late in March. The exact date was not known as we went to press. It was also reported that Lassie, Timmy, and Miss Lockhart "did a most effective and appealing job."

Western Gall Rust Cankers in Lodgepole Pine

Roger S. Peterson

IT IS STRANGE that the most common and damaging fungus canker on Rocky Mountain lodgepole pine has never been fully described. Branch galls caused by western gall rust (*Peridermium harknessii* Moore) are well known, but the malformation that this fungus causes on trunks (Fig. 1) has generally been ignored, blamed on dwarfmistletoes, or ascribed to other rust fungi. With present increased utilization of lodgepole, (*Pinus contorta* Dougl. ex Loud.), canker damage can no longer be neglected.

Nomenclature, Hosts, and Range

Gall rust cankers are known in various parts of the West as "hip-cankers," "cat-faces," "cat's eyes," and "monkey-faces." The causal fungus is similarly supplied with a variety of names, of which the oldest and clearest is *Peridermium harknessii*. The nomenclatural tangle has been discussed elsewhere (*4, 8, 9*).

Probably all of the western hard pines can serve as hosts to this native rust, and specimens have been collected on seven pine species, in all the states and provinces west of the Great Plains and north of Mexico (*9*). On jack pine (*Pinus banksiana* Lamb.) the fungus is probably transcontinental (*1, 10, 11, 12*). Many eastern and exotic hard pine species have proved susceptible to western gall rust in plantations and in inoculation experiments (*2, 9*). However, only on lodgepole pine and to a lesser extent on ponderosa pine are abundant trunk cankers found; on other hosts only branch galls and short-lived stem galls are common.

THE AUTHOR is plant pathologist, Rocky Mountain Forest and Range Expt. Sta. Forest Service, U. S. Dept. Agric., with central headquarters at Fort Collins in cooperation with Colorado State University.

The research reported was conducted from the Station's Forest Disease Laboratory at Fort Collins, Colo.

Development on Lodgepole Pine

Where gall rust infects a pine branch, it stimulates the host cambium to excessive activity, and a distinct gall develops. The resulting deformity is a subglobose, pear-shaped, or occasionally fusiform gall, well illustrated by Hubert (*5*). The twig may be encircled in a single year, but more frequently the gall extends around a branch less rapidly, and several years may be required to complete the circuit. Because of breakup of the gall bark, the branch part distal to the gall dies within a few years of encirclement. The rust dies with its host branch. Such galls do little harm unless they are numerous enough to kill most of a tree's needle-bearing branches. Tree mortality from galls appears to be uncommon in all but the seedling stage of lodgepole pine.

On main stems girdling may progress as it does on branches (top of Fig. 1), but usually there is quite a different result. Although a globose gall begins to form, tangential growth of the rust does not overtake that of the host, and the gall is limited to one side of the trunk (Fig. 2). As on the branch gall, breakup of the bark causes death of this "primary gall" after two or more years. But unlike the branch, a trunk offers adjacent living areas for the rust to invade. Growth of the rust is mainly at right angles to the stem axis. Therefore, to the left and right of the primary gall, "secondary galls" develop from the newly-invaded cambium, and appear as concentric, curved ridges (Fig. 3).

This process—invasion, gall formation, and necrosis—occurs repeatedly during growth of a canker, and in one instance was observed to extend over at least 277 years. Active cankers 200 years old are common in virgin lodgepole. The primary gall may eventually be buried by later growth of nearby tissue, or it may break off if it is on a branch base.

Presence of a canker on one side of a tree stimulates growth in the rust-free sides of the trunk (Fig. 1). The uninfected wood is not pathological; unlike the xylem in galls, it is composed of normal tracheids and rays in the usual ratio of abundance. But this unbalanced growth, as much as the diseased tissue itself, contributes to the cull caused by gall rust.

Vertical growth of the rust is usually slight. Occasionally, however, the mycelium (body of fungus filaments) elongates relatively rapidly parallel to the wood grain. Abnormal cell divisions in the invaded cambium give rise to narrow ridges extending upward or downward from the main horizontal zone of growth (Fig. 3).

The vertical extent of a trunk canker is not limited to the region invaded by the fungus. Exposed dead wood often extends in long triangles both up and down (Fig. 4). These triangles, although sometimes similar to *Peridermium stalactiforme* cankers resulting from vertical growth of that rust (*8*), have not been observed to contain mycelium. No aecia (spore sacs) or mycelium could be located at their edges in hundreds of field examinations or scores of microscope sections.[1] Often the triangles

[1]The staining technique of Jewell (*6*) was used. In all sections from gall tissue, mycelium was clearly differentiated by this method. No mycelium was observed in any section taken more than one centimeter from a gall.

are mirror images above and below the center, and they may extend for six feet in each direction.

Unusual canker shapes result when the bark of a primary gall lives for many years, or when the rust dies out on one side. In the first instance, a hemispherical gall up to two feet in diameter may result; in the second, there develops a "one-sided" canker in which the primary gall is at an edge rather than the center.

FIG. 1.—Two forms of attack by *Peridermium harknessii* on lodgepole pine: the original stem leader was girdled by a globose gall (arrow), and rust cankers have deformed the lower trunk. Roosevelt National Forest, Colo.

Damage to Pines

Economic loss resulting from *P. harknessii* in lodgepole pine results mainly from cull caused by trunk cankers. This view is in contrast to that of Hubert, (*5*), who believed that gall rust causes "considerable damage to seedlings and minor damage to mature trees." It is true that in the Inland Empire of the Northwest, where Hubert made his observations, thousands of seedlings per acre may be killed by this pathogen. Near Nordman, Idaho, there are now stands in which serious, though temporary, understocking has been caused by gall rust. Yet the area is remarkably free of gallrust trunk cankers.

To the east, however, in the Continental Divide area of Montana and southward to northern Colorado and northeastern Utah, where lodgepole is the principal commercial species, seedling mortality does not seem to be an important damage factor. Cankers, on the other hand, can be found in most lodgepole stands, and in some more than half of the trees are affected. No extensive surveys have been made to evaluate gallrust damage on a regional basis; the few available figures are for selected plots (*5*, *9*).

The majority of *P. harknessii* cankers penetrate deep into the trunk, and cause serious malformation and weakness. Cankered trees are useless for transmission line poles (*7*). Boards sawn from such trunks are structurally weak and irregularly discolored. Merchantable sized cankered stems cannot be fully utilized for sawlogs, the amount of cull depending on the number and position of the lesions that must be cut out. Short products such as cross-ties, mine props, and pulpwood offer the only economic utilization of some badly cankered stands that could otherwise be cut for sawtimber. Effects of the highly resinous rust-infected tissue on pulp quality have not been assessed.

Control

Control of gall rust is not yet feasible except in the course of thinning and in intermediate cuts, when cankered stems should be removed. It is hoped that with increasing knowledge of the pathogen's life cycle more general silvicultural controls can be suggested.

Pruning of branch galls is possible and has been carried out in ponderosa and Scotch pine plantations, but it is generally impractical. Unless a gall is within a few centimeters of the trunk, it can do little harm.

FIG. 2.—A hemispherical gall at the center of a *Peridermium harknessii* canker on lodgepole pine. Usually the primary gall is less obvious because of overgrowth by the surrounding tissue. Kootenai National Forest, Mont.

FIG. 3.—Secondary galls near the center of a *Peridermium harknessii* canker on lodgepole pine. Each gall lives for a few years, then is succeeded by a new swelling further from the primary gall. Roosevelt National Forest, Colo.

FIG. 4.—An elongated gall rust canker on lodgepole pine. The rust itself was limited to the center of the canker. Roosevelt National Forest, Colo.

In 1933, Colorado foresters cut the rust cankers from seven lodgepole pines. No noticeable decay was introduced in the resulting scars after twelve years, and rust infection was eliminated in five or six of the trees, whereas untreated cankers continued to develop.[2] Of course such surgery is practical only for trees of special value.

Possibilities of control by antibiotics and by breeding for host resistance have scarcely been explored for this disease, but they offer some hope.

P. harknessii should be carefully excluded from regions beyond its range, particularly the southeastern states and Europe. Probably the southern pines have already been "exposed" and conditions have not proved suitable for the fungus, but this is not a certainty. Scotch pine in Europe has not been exposed, so far as is known. Boyce (*3*) in this regard called *P. harknessii* "probably the most dangerous of all tree rusts if disseminated from its present range."

[2]Heaton, P. L. *Peridermium* canker study; progress report. Pike National Forest, Colorado Springs. December 5, 1945. Typescript. 2 pp. 1945.

Summary

On lodgepole pine, trunk cankers are the principal form of damage due to western gall rust, *Peridermium harknessii*. Cankers caused by this parasite begin growth from primary galls. After breakup of the gall bark, the fungus spreads horizontally to adjacent tissue, where secondary galls develop. Cankers may increase in size for a century or two without killing the host.

Trunk malformations caused by gall rust result in significant cull, at least where infested stands are cut for poles or sawlogs. Control, except by cutting out diseased stems during thinning, is not yet practicable.

Literature Cited

1. BOURCHIER, R. J. 1954. Alberta and Rocky Mountain National Parks; forest disease survey. Ann. Rept. For. Ins. and Dis. Surv. for 1953. Can. Dept. Agric. pp. 128-135.
2. BOYCE, J. S. 1943. Host relationships and distribution of conifer rusts in the United States and Canada. Conn. Acad. Arts and Sci. Trans. 35: 329-482.
3. ———. 1954. Forest plantation protection against diseases and insect pests. FAO For. Devel. Paper 3. 41 pp.
4. ———. 1957. The fungus causing western gall rust and Woodgate rust of pines. For. Sci. 3: 225-234.
5. HUBERT, E. E. 1931. An outline of forest pathology. John Wiley and Sons, New York. 543 pp.
6. JEWELL, F. F. 1958. Stain technique for rapid diagnosis of rust in southern pines. For. Sci. 4: 42-44.
7. LEBARRON, R. K. 1952. Silvicultural practices for lodgepole pine in Montana. Northern Rocky Mountain Forest and Range Expt. Sta. Sta. Paper 33. 19 pp.
8. MIELKE, J. L. 1956. The rust fungus (*Cronartium stalactiforme*) in lodgepole pine. Jour. Forestry 54: 518-521.
9. PETERSON, R. S. 1959. Pine gall rust in the Rocky Mountains. Ph.D. thesis. Univ. Michigan, Ann Arbor. 111 pp.
10. POMERLEAU, R., and J. BENAZET. 1957. Province of Quebec; forest disease survey. Ann. Rept. For. Ins. and Dis. Surv. for 1956. Can. Dept. Agric. pp. 35-38.
11. THOMAS, R. W. 1953. Provinces of Manitoba and Saskatchewan; forest disease survey. Ann. Rept. For. Ins. and Dis. Surv. for 1952. Can. Dept. Agric. pp. 92-99.
12. ———. 1954. Province of Manitoba and Saskatchewan; forest disease survey. Ann Rept. For. Ins. and Dis. Surv. for 1953. Can. Dept. Agric. pp. 104-111.

White Pine Seed Consumption by Small Mammals[1]

Herschel G. Abbott

THE REVIVAL of interest in reforestation by direct seeding has reemphasized several long existing and basic biological problems associated with the regeneration of forest stands. One of these problems concerns the impact of small mammals upon tree seed crops produced naturally in the forest as well as upon seed supplied to specific areas in controlled quantities and by various techniques known collectively as direct seeding.

A review of existing knowledge regarding tree seed destruction by animals points to a dearth of detailed information on this subject, especially as it relates to specific species of mice and voles. In 1947, Smith and Aldous (*5*) stated that "Many workers have deplored serious losses by rodents and birds without specifying the identity of the animals concerned. In fact, the writers—found it impossible to attribute given instances of seed destruction to specific animals." In 1941, Hamilton (*2*) pointed out that "the ecologic and economic significance of our small mammals has long been overlooked by field biologists." It is generally accepted that among the seed-eating mammals, white-footed mice (*Peromyscus* spp.) are particularly significant in their effect on forest regeneration. However, in 1958, Hooven (*3*) wrote that "little information is available concerning the habits of the white-footed deer mouse (*Peromyscus maniculatus*) in relation to seedling establishment."

Numerous papers have been published which merely refer to the fact that tree seed is destroyed by small mammals, but few investigators have studied the qualitative or quantitative aspects of animal pressures on reforestation. Probably the most often cited of all papers on this subject is that of Willis (*8*) written in 1914 in which he credits individual white-footed mice (probably *Peromyscus maniculatus*) as having consumed 300 Douglas-fir (*Pseudotsuga menziesii* [Mirb. Franco]) seeds daily. Shaw (*4*) has reported that a deer mouse (*Peromyscus* spp.) will consume 200 Douglas-fir seeds in a day even when other foods are available, and that they will also collect and store these seeds. Spencer (*6*) mentions that "as few as six deer mice (*Peromyscus*) per acre can largely nullify a program in which Douglas-fir seed is broadcast at the rate of one-fourth pound per acre." Hamilton (*2*) has released seed consumption data based on stomach analyses indicating that under natural conditions, adult deer mice, jumping mice, and red-back voles eat daily about 30 percent of their weight or approximately six grams of food, while short-tailed shrews (*Blarina brevicauda*) eat about one-half their weight or nine grams. This is in addition to the food which they store, much of which may never be eaten.

It has been realized for many years that failures in direct seeding have been caused, at least in part, by the activities of mice and other seed-eating mammals. The treatment of tree seed with such recently developed chemicals as Endrin[2] to poison or repel these animals has provided a degree of protection against their depredations in some direct seeding work. Foresters seem to have been less cognizant of the influence of small mammals on natural regeneration, particularly in the Northeast. A recent publication (*7*) reviewing the accumulated knowledge on managing eastern white pine fails to mention small mammals in its discussion of the biological bases of white pine management. It is this author's opinion, however, that naturally disseminated seed crops of white pine and other species may be so adversely affected by small mammals that they should be considered as the limiting factor in the successful regeneration of such forest stands.

Certainly, some very fundamental and useful knowledge could be gained by studying the ecological role played by small mammals in the forest with special emphasis upon (1) their seed-eating potential, (2) species preference, and (3) their population density in various forest types, especially during the period from seed dissemination until germination is completed.

During the winter of 1957-1958, a research project was initiated at the University of Massachusetts to study the species preference and seed-eating potential of three species of mice and voles; namely, the white-footed mouse (*Peromyscus leucopus*), the boreal redback vole (*Clethrionomys gapperi*), and the common meadow vole (*Microtus pennsylvanicus*).

Laboratory experiments with caged animals were conducted using white pine and several other species of coniferous seed. In the fall of 1958, a field study was also made of white pine seed consumption by small mammals. This paper reports the results of this field study and presents some of the data obtained from the feeding

THE AUTHOR is assistant professor, Department of Forestry and Wildlife Management, University of Massachusetts, Amherst.

[1]Contribution Number 1217 of the Massachusetts Agricultural Experiment Station, Amherst.

[2]Endrin is the trade name of a highly toxic insecticide which is used in formulation with Arasan (thiuram), a fungicide which has proven very effective as a bird repellent.

of white pine seed to animals confined in the laboratory.

Laboratory Experiments

Data obtained on the capacity of small mammals to consume white pine seed is presented in Table 1. Five white-footed mice were confined separately in specially designed laboratory cages (*1*) and were fed a water and pine seed diet for a combined total of 140 ration periods of 24 hours each. Each ration consisted of 200 white pine seeds, supplemented with a constant supply of water. A total of 15,340 seeds were consumed during the 140 ration periods for an average daily consumption of 109 seeds per mouse. The minimum and maximum numbers of seeds eaten by any one mouse during a 24-hour period were 65 and 199, respectively.

Similarly, five meadow voles were fed white pine seed for seven days or a total of 35, 24-hour ration periods. Each of these rations consisted of 300 seeds. A total of 4,831 seeds were consumed for an average daily consumption per animal of 138 seeds. The minimum daily consumption was 63 seeds per mouse and the maximum number eaten in any one day was 272 seeds.

Three boreal red-back voles, when fed white pine seed, consumed a total of 7,304 seeds in 25 days. Their daily seed consumption per mouse ranged from 0 to 228 with an average of 97 seeds for the 75 ration periods.

These figures indicate the seed-eating capacity of mice and voles but do not provide a realistic picture of the potential of these animals to destroy seeds in the wild. There are several factors which might cause the preceding seed consumption figures to be inconsistent with similar laboratory data and more particularly with the seed-eating potential of small mammals in the forest.

The animals used in these feeding experiments were confined in small cages and were, therefore, unable to exercise freely. Thus it would seem that their food intake might logically be less than in the wild where more energy would be expended. There is little natural incentive for caged animals to store food when they are housed in a laboratory at room temperature. In none of these laboratory studies was the practice of seed storage attempted by the animals confined.

TABLE 1.—NUMBER OF EASTERN WHITE PINE SEED CONSUMED BY SMALL MAMMALS IN LABORATORY EXPERIMENTS

Animal	No. of seeds fed per ration	No. of animals fed	No. of 24-hour ration periods	Total no. seeds consumed	Daily seed consumption Min.	Max.	Av.
White-footed Mouse	200	5	140	15,340	65	199	109
Red-back Vole	300	3	75	7,304	0	228	97
Meadow Vole	300	5	35	4,831	63	272	138

The size of tree seed (expressed in number of seeds per pound) as well as its viability, will influence the number of seeds consumed in any given period of time. The smaller the seed, the greater the number which will be consumed and a high viability percentage will reduce the number of seeds required to satisfy an animal's food demands.

Although individual weight differences between mice of the same species might have some influence on the quantities of seeds consumed, no correlations were found between body weight and seed consumption of the animals (all adult males) used in these experiments.

These data, resulting from laboratory-feeding experiments, must be used with caution in evaluating the seed-eating capacity of small mammals in the field. They do, however, furnish a basis for setting broad perimeters for white pine seed consumption by white-footed mice, red-back voles, and meadow voles in their natural habitats.

Field Study

A more determinative approach to studying the influence of small mammals on tree seed crops was begun in the fall of 1959 when a field experiment was initiated. A rectangular one-half acre plot (104 × 208 feet) located in an abandoned juniper pasture was chosen for this study. The area was selected largely because of its accessibility, but also because direct seeding plots previously established in similar vegetative types had been adversely affected by small mammals.

The woody vegetation was predominantly common juniper (*Juniperus communis* L.) interspersed with eastern red cedar (*Juniperus virginiana* L.), gray birch (*Betula populifolia* Marsh.), red maple (*Acer rubrum* L.), smooth sumac (*Rhus glabra* L.), shining sumac (*Rhus copallina* L.), hawthorn (*Crataegus* spp.), sweetfern (*Comptonia peregrina* [L] *Coult.*), and meadowsweet (*Spiraea latifolia* [Ait.] *Borkh.*). Bunchgrass (*Andropogan scoparius Michx.*) and hair-cap moss (*Polytrichum commune Hedw.*) covered much of the ground surface of the openings in the juniper.

Four feeding stations were located approximately 75 feet apart along a line running diagonally across the plot. A feeder box (Fig. 1) was placed at each of these stations. These feeders consisted of a box-like frame approximately 14 inches square and three inches in depth with a bottom of copper screening. This base served as a tray to hold the seed to be exposed for animal feeding. A similar structure, inverted and hinged to the tray, served as a cover and prevented invasion by large mammals and birds. Hook and eye fasteners were attached to hold the cover firmly in a partially closed position. Screws inserted in the upper edge of the feeder-tray front piece prevented the cover from closing tight upon the tray and provided a space, 1 inch in height, for animals to enter the feeder (Fig. 2). Pieces of asphalt roofing paper were placed over the feeders late in the fall to protect the seeds from snow and rain.

On October 3, one ounce of white pine seed was exposed in each of the four feeders. The area was subsequently visited once every 24 hours to observe the rate of seed consumption and to resupply the feeders with seed. No feeder was resupplied until it was apparent

FIG. 1.—Feeder box in open position for seed inspection. Note neat pile of uneaten seeds in center and the empty seed coats around its periphery.

FIG. 2.—Feeder box in the closed or set position.

that all but an occasional seed had been consumed or removed. Each time a feeder was replenished with seed, the empty seed coats were recovered and carefully examined in the laboratory to record the amount of uneaten seed and to determine the number of empty seed coats in relation to the number of seeds fed. The one-ounce feedings were continued for 37 days. During this time, it was necessary to resupply three of the feeders 31 times, and a fourth on 30 days. A total of 123 ounces of seed were therefore consumed (Table 2).

To determine the magnitude of the daily seed consumption by small mammals on the area, the feedings were increased to two ounces, beginning November 9. It was again necessary to visit the area each day, although the two-ounce feedings were not completely consumed as frequently as were the one-ounce feedings. At station No. 1, sixteen two-ounce feedings were consumed in the 23-day period during which this quantity of seed was exposed. At stations II, III, and IV, 11, 13, and 15 feedings were eaten or removed from the feeders making a total of 110 ounces for all four stations during this period.

The last five days in November brought a drop in temperature and a noticeable decrease in the amount of seed consumed daily. Therefore, on December 2, one-ounce feedings were again resumed and were continued for the remainder of the study. A total of 22 ounces of seed were consumed during an 8-day period.

As is shown in Table 2, 15 pounds and 15 ounces of white pine seed (373,065 seeds) were either eaten or removed and presumably stored in a 68-day period. This represents an average daily seed loss of 3.7 ounces (5,486 seeds).

An effort was made to determine the quantity of seed removed from the feeders compared to that actually eaten as evidenced by the presence of empty seed coats. A visual inspection of the quantity of seed coats remaining in the feeder after each 24-hour period indicated that much of the seed exposed was actually eaten by the animals *in situ*. Figure 3 presents a comparison between 10 pounds of whole white pine seed and the empty seed coats left in the feeders from 10 pounds of seeds exposed. Ten samples, each of a weight equal to .001 of this quantity of seed coats, were carefully counted and gave an average of 118. This figure, when compared to .001 of ten pounds of whole seed (23,406 seeds per pound), indicates that 50.5 percent or about one-half of the seeds were eaten within the confines of the feeder. The remaining seeds presumably were stored.

With the arrival of the first snowfall, the seed consumption study was terminated and traps were set to capture the seed-eating animals that had been visiting the feeders during the previous 68 days. One-ounce quantities of pine seed were again exposed (as bait) and three Museum Special snap traps were placed, unbaited, in each of the four feeders. The first night of trapping resulted in a catch of two white-footed mice and two red-back voles. These animals became caught by springing the traps during their accustomed feeding activities.

The use of unbaited traps having established the species of animals involved, trapping time was reduced by placing peanut butter on the pans of the traps. A fresh supply of pine seed was placed in the feeders each day. Eight ounces of white pine seed were consumed during the total trapping period. Trapping was contained for eight additional days and resulted in a total catch of 22 animals, 14 of which were white-footed mice and the remaining eight, red-back voles. The small accumulation of snow, which had fallen prior to the trapping period, made it possible to observe tracks of all visiting animals. When no fresh tracks could be seen and the pine seed was left untouched, trapping was stopped.

The number of animals captured by trapping furnishes a rather

TABLE 2.—WEIGHT OF EASTERN WHITE PINE SEED[1] CONSUMED BY SMALL MAMMALS IN A 68-DAY PERIOD (Field Study)

Exposure period	Wt. of seed exposed daily	Exposure stations I: No. days seed replenished	I: Wt. of seed consumed	II: No. days seed replenished	II: Wt. of seed consumed	III: No. days seed replenished	III: Wt. of seed consumed	IV: No. days seed replenished	IV: Wt. of seed consumed	Total wt. seed consumed
	Oz.	*No.*	*Oz.*	*No.*	*Oz.*	*No.*	*Oz.*	*No.*	*Oz.*	*Oz.*
10/13-11/8 (37 days)	1	31	31	30	30	31	31	31	31	123
11/9-12/1 (23 days)	2	16	32	11	22	13	26	15	30	110
12/2-12/9 (8 days)	1	6	6	4	4	6	6	6	6	22
		53	69	45	56	50	63	52	67	255
			4 lbs. 5 oz.		3 lbs. 8 oz.		3 lbs. 15 oz.		4 lbs. 3 oz.	15 lbs. 15 oz.

[1]Commercially cleaned seed, 23,406 seeds per lb., viability 48%, purity 93%.

accurate census of the small mammal population responsible for the seed destruction described. With the first three nights of trapping producing one-half the total catch, it is unlikely that new animals moved into the area during the brief trapping period. It is entirely probable that some mice may have been removed from the plot through predation and other natural factors. However, the consistency of daily seed consumption throughout the 68-day seed exposure period points to a relatively stable population.

By applying the ratio of daily seed consumption of these two species of animals in the laboratory (97:109) to the total number of seeds eaten and stored by them in the field, it is estimated that each red-back vole destroyed 232 seeds per day and each white-footed mouse, 260 seeds.

It is obvious that any food as small as white pine seed can be more readily found and destroyed by small mammals, when conspicuously exposed in large quantities, than when scattered over the ground by natural means of dissemination. It would be presumptuous, therefore, to assume that the same quantitative destruction of seed as found in this study would have necessarily occurred under conditions of natural seed fall. However, it should be pointed out that the figures given here do not represent the maximum seed-eating potential of the animals involved. Had the study been initiated a month earlier, at the beginning of the seed dissemination period, and had greater quantities of seed been exposed, the amount of seed destroyed would have been appreciably larger. Regardless of these factors, the data presented are believed to be a significant indication of the tremendous potential of white-footed mice and red-back voles to adversely influence the regeneration of eastern white pine.

Conclusions

The results of this study show that mice and voles, which constitute only one segment of the small mammal population in the forest, are capable of destroying large numbers of eastern white pine seed. These animals, when occurring in substantial numbers, can consume quantities of pine seed far in excess of those amounts which it is economically feasible to sow in direct seeding work. They also have a seed-eating potential so great as to be capable of eating and storing all naturally disseminated seed except that which is undetected in their feeding activities.

Summary

Laboratory experiments with caged white-footed mice, boreal red-back voles, and meadow voles indicated their potential as consumers of eastern white pine seed. White-footed mice ate an average of 109 seeds per day; red-back voles, 97; and meadow voles, 139 seeds.

White pine seed exposed in four feeders placed on a one-half acre plot in an abandoned juniper pasture were eaten avidly by small mammals. Fifteen pounds and fifteen ounces of seed (373,065 seeds) were eaten or removed from the feeders in a 68-day period from October 3 to December 9.

The species and number of animals responsible for destroying the exposed seed were determined by trapping. Fourteen white-footed mice and eight red-back voles were caught.

An analysis of the empty seed coats left in the feeders at the end of each day showed that approximately one-half the seeds were eaten, the other half presumably stored.

White-footed mice were credited with destroying 260 seeds per animal, daily, compared to 232 seeds destroyed by each red-back vole.

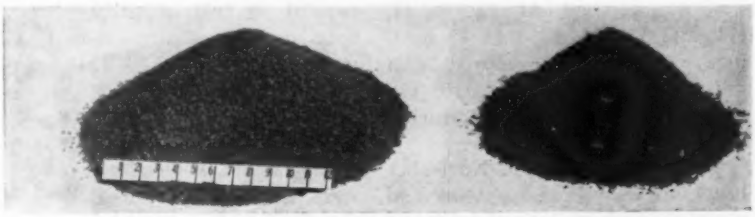


FIG. 3.—Ten pounds of whole white pine seed (left) and empty seed coats (right) recovered from feeders after exposing ten pounds of seed to feeding by mice.

Literature Cited

1. ABBOTT, HERSCHEL G., and DANA P. SNYDER. 1959. A laboratory cage for small mammals. Jour. Mammology 40 (4) 618-620.
2. HAMILTON, W. J., JR. 1941. The food of small forest mammals in eastern United States. Jour. Mammalogy 22 (3) 250-263.
3. HOOVEN, EDWARD. 1958. Deer mouse and reforestation in the Tillimook Burn. Research Note No. 37. Oregon Forest Lands Research Center.
4. SHAW, ELMER W. 1954. Direct seeding in the Pacific Northwest. Jour. Forestry 52:827-828.
5. SMITH, CLARENCE F., and SHALER E. ALDOUS. 1947. The influence of mammals and birds in retarding artificial and natural reseeding of coniferous forests in the United States. Jour. Forestry 45:361-369.
6. SPENCER, DONALD A. 1954. Rodents and direct seeding. Jour. Forestry 52:824-826.
7. U. S. FOREST SERVICE. 1959. What's known about managing eastern white pine. Northeastern Forest Experiment Station. Station Paper No. 121.
8. WILLIS, C. P. 1914. The control of rodents in field seeding. Proc. Soc. Amer. Foresters, No. 9. 365-379.

Tree Percent on Burned and Unburned Longleaf Seedbeds

Lloyd F. Smith

IN A STUDY in south Mississippi, establishment of longleaf pine (*Pinus palustris* Mill.) seedlings was markedly aided by a preseedfall burn to eliminate the ground cover of grass and needles. In addition to corroborating other research (*1, 2, 3, 4, 5, 6*) as to the value of seedbed preparation, the study yielded detailed data on the distribution of seedfall and seedlings —information that may be helpful to the design of future seedfall samples.

Methods

The study area, on the McNeill Experimental Forest, consisted of 222 acres of second-growth longleaf pine in six blocks ranging from 28 to 46 acres in size. Average stand age was 43 years. All blocks were unevenly stocked (20 to 46 pines 10 inches d.b.h. and larger per acre), and had numerous openings where additional reproduction was needed (Fig. 1).

In September, 1955, before seedfall, half of each block (selected at random) was burned to expose the mineral soil. The rough varied from 6 to 10 years of age in the different blocks and consisted mainly of grasses and pine litter.

Seedfall was sampled by one-quarter milacre traps spaced at 2-chain intervals on two transects across each of the two plots in each block. Thus there were 10 traps on each burned plot and 10 on each unburned plot in each of 6 blocks, or a total of 120 traps on the study area. In addition, a quarter-milacre subplot was located near each seed trap for observations of germination and seedling survival. Seeds were collected from the traps five times between October 31, 1955, and February 15, 1956. The seedling reproduction subplots were examined four times between December 13, 1955, and March 6, 1957.

Because of the high degree of variation and the fact that only 6 replications were available, only one major treatment difference proved statistically significant: the difference in tree percent between burned and unburned seedbed condition 1½ years after seedfall.

Seed Production

Seedfall began about October 15, 1955, and continued for about 120 days. Approximately 19 percent of the total sound seed had fallen by October 31, 80 percent by November 21, and the remainder by February 15, 1956 (Table 1). Production of sound seed on individual half-blocks ranged from 8,400 to

THE AUTHOR is on the staff of the Southern Institute of Forest Genetics, Southern Forest Expt. Sta., Forest Service, U. S. Dept. Agric., Gulfport, Miss.

FIG. 1.—Representative view of experimental stands. Note large crowns of the open-grown longleaf seed trees and unstocked opening.

TABLE 1.—CUMULATIVE DISTRIBUTION OF SOUND LONGLEAF SEED TRAPPED ON VARIOUS DATES

Date	Days since seedfall began	Cumulative proportion of sound seed trapped by date
	Number	*Percent*
1955		
October 31	16	19.2
November 21	37	79.9
December 9	55	91.4
1956		
January 17	94	98.8
February 15	123	100.0[1]

[1]Estimate of the total number of seeds trapped was 44,567 per acre. Estimate of the number of sound seeds was 29,100 per acre.

TABLE 2.—TREE PERCENT (RATIO OF SEEDLINGS TO SOUND SEED SUPPLY) AFTER ONE GROWING SEASON

Block	Unburned seedbed			Burned seedbed		
	Sound seedfall 1955	Seedlings alive, 1957	Tree percent	Sound seedfall 1955	Seedlings alive, 1957	Tree percent
	Number per acre			*Number per acre*		
1	36,400	1,600	4.4	37,200	2,400	6.4
2	32,400	800	2.5	31,200	5,200	16.7
3	34,800	1,200	3.4	26,400	2,000	7.6
4	46,400	400	.9	38,400	3,600	9.4
5	20,400	0	0	19,600	1,200	6.1
6	17,600	800	4.5	8,400	400	4.8
Mean per acre	31,333	800	2.6	26,867	2,467	9.2

46,400 per acre (Table 2). Differences in seedfall between burned and unburned plots were not significant, although differences in seedfall among blocks were significant (by analysis of variance). This situation pointed up the gain in efficiency from the randomized block design. The distribution of traps according to block, treatment, and number of seeds trapped by each is shown in Table 3. An average of 7.275 sound seeds were caught per trap, or a mean of 29,100 sound seeds per acre. The coefficient of variation per trap was 97 percent, and the ratio of variance to mean was 6.86.

Seedling Establishment

The fall and winter of 1955 were deficient in rainfall at McNeill. Departure from the normal varied from —2.56 inches in August to —0.71 inches in November. A deficit of 7.44 inches accumulated during the four months and continued through February, 1956, when the deficit for the seven months reached 11.57 inches.

When the first seedling examination was made on December 13, 1955, there were 1,933 living seedlings per acre on the unburned areas and 3,133 on the burned; live seedlings were tallied on 38 percent of the burned subplots and 30 percent of the unburned. Table 4 summarizes progress of the seedlings to March 6, 1957. At this date the unburned areas averaged 800 seedlings per acre and only 15 percent of the subplots had seedlings. The burned areas had 2,467 seedlings per acre, and 40 percent of the subplots were stocked. Clearly, mortality was much heavier on the unburned rough.

In all 6 blocks, tree percent on the burned half exceeded that on the unburned, a phenomenon which would occur only 1 time out of 64 by chance alone (i.e., it is significant at the 2-percent level). Table 4 shows sound seedfall, established seedlings, and tree percent by block and treatment.

Table 5 shows in detail the distribution of ¼-milacre quadrats by block, treatment, and number of seedlings surviving in March, 1957. The mean number of seedlings per quadrat was 0.200 on the unburned

TABLE 3.—DISTRIBUTION OF 1955 LONGLEAF SOUND SEED CATCH IN 120 ¼-MILACRE SEED TRAPS

Block	Previous ground treatment	Number of seeds caught in individual ¼-milacre traps																													Total seeds per 10 traps	Variance of catch of individual trap
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	....	48		
		Number of traps catching indicated number of seeds																													*No.*	*Seeds*
1	Unburned					3	1	1		1	1						1		1		1										91	33.4
	Burned		1	1	2			1				1	1		1						1						1				93	63.3
2	Unburned		1		1		3	1						2				2													81	29.4
	Burned				2	1	2	1		2							1						1									78	34.0
3	Unburned					3	1			2	3																		1			87	46.2
	Burned		1	1	1		3			1	1		1						1													66	23.2
4	Unburned			1			1	1		1		1		1		1	1			1								1				116	49.8
	Burned	1		3		1	2					1								1										1		96	209.4
5	Unburned		2	2	1	3		1																		1						51	46.5
	Burned		4		1	1		1	1		1								1													49	23.4
6	Unburned		2	1	1	3			1	1		1																				44	9.2
	Burned	2	2	3	1		2																									21	3.2
Totals																																
	Unburned		5	4	3	12	6	4	1	5	4	2		3		1	2	2	1	1	1				1		1	1			470	38.8
	Burned	3	8	8	7	3	9	3	1	3	2	2	2		1		1	1	1	1	1		1			1				1	403	61.3
Grand total																																
	Both	3	13	12	10	15	15	7	2	8	6	4	2	3	1	1	3	3	2	2	2		1			1	1	1	1	1	873	49.9[1]

[1]Burned and unburned plots combined:

Mean catch in 120 traps = 7.275 seeds per trap, or 29,100 per acre

Standard deviation per trap = 7.06 seeds

Coefficient of variation = 97 percent

Ratio of $\frac{\text{variance}}{\text{mean}}$ = 6.86

Proportion of traps blank = 2½ percent

and 0.617 on the burned, with coefficients of variation of number of seedlings per quadrat being 257 percent and 161 percent respectively. The ratio of variance to mean was 1.32 for the unburned and 1.60 for the burned quadrats.

The quarter-milacre stocking figures (40 percent for burned seedbed and 15 percent for unburned) are not readily translatable into milacre stocking percents. Most foresters, however, will agree that 2,467 seedlings per acre on 1,600 out of a possible 4,000 burned quarter-milacres at the beginning of the second growing season is satisfactory—and that 800 seedlings per acre on 600 out of a possible 4,000 unburned quarter-milacres is unsatisfactory.

TABLE 4.—NUMBER OF LIVING LONGLEAF SEEDLINGS AND PROPORTION OF ¼-MILACRE PLOTS WITH SEEDLINGS AT VARIOUS DATES

Date	Live seedlings per acre		¼-milacre plots with live seedlings	
	Unburned seedbed	Burned seedbed	Unburned seedbed	Burned seedbed
	Number		*Percent*	
December 13, 1955	1,933	3,133	30	38
January 18, 1956	1,600	3,467	28	40
April 4, 1956	1,000	2,867	23	40
March 6, 1957	800	2,467	15	40

TABLE 5.—DISTRIBUTION OF 1955 LONGLEAF SEEDLINGS SURVIVING IN MARCH 1957 ON 120 ¼-MILACRE QUADRATS

Block	Previous ground treatment	Number of seedlings on individual ¼-milacre quadrats						Total seedlings per 10 quadrats	Variance of individual quadrat
		0	1	2	3	4	5		
		No. of quadrats in each class							*Seedlings*
1	Unburned	7	2	1				4	0.489
	Burned	8			2			6	1.600
2	Unburned	9		1				2	.400
	Burned	1	6	2	1			13	.678
3	Unburned	8	1	1				3	.456
	Burned	5	5					5	.278
4	Unburned	9	1					1	.100
	Burned	5	4				1	9	2.322
5	Unburned	10						0	.000
	Burned	8	1	1				3	.456
6	Unburned	8	2					2	.178
	Burned	9	1					1	.100
Total	Unburned	51	6	3				12[1]	.264[1]
	Burned	36	17	3	3		1	37[2]	.986[2]

[1]Unburned:

Mean number of seedlings in 60 quadrats	= .200 seedling
Standard deviation per quadrat	= .514 seedling
Coefficient of variation	= 257 percent
Ratio of $\frac{\text{variance}}{\text{mean}}$	= 1.32
Proportion of quadrats blank	= 85 percent

[2]Burned:

Mean number of seedlings in 60 quadrats	= .617 seedling
Standard deviation per quadrat	= .993 seedling
Coefficient of variation	= 161 percent
Ratio of $\frac{\text{variance}}{\text{mean}}$	= 1.60
Proportion of quadrats blank	= 60 percent

Literature Cited

1. BRUCE, D., and C. A. BICKFORD. 1950. Use of fire in natural regeneration of longleaf pine. Jour. Forestry 48: 114-117. Illus.
2. CHAPMAN, H. H. 1926. Factors determining natural reproduction of longleaf pine on cut-over lands in La Salle Parish, Louisiana. Yale Univ. School Forestry Bul. 16, 44 pp. Illus.
3. ————. 1936. Effect of fire in preparation of seedbed for longleaf pine seedlings. Jour. Forestry 34: 852-854.
4. OSBORNE, J. G., and V. L. HARPER. 1937. The effect of seedbed preparation on first-year establishment of longleaf and slash pine. Jour. Forestry 35: 63-68.
5. ROBERTS, E. G. 1936. Germination and survival of longleaf pine. Jour. Forestry 34: 884-885.
6. WAHLENBERG, W. G. 1935. Effect of fire and grazing on soil properties and the natural reproduction of longleaf pine. Jour. Forestry 33: 331-338.

Correction

On page 51, January 1961 issue, the "Report of the Committee on Forest Tree Improvement" should have been credited to R. T. Bingham who is chairman of that committee, rather than to Paul O. Rudolf, who is chairman of the Seed Certification Subcommittee.

Correction

On page 164, February 1961 issue, James Burton Millar was erroneously listed as the chairman of the Program Committee of the 1961 annual meeting. Mr. Millar is a member of the committee, but the chairman is George B. Amidon, Minnesota and Ontario Paper Co., International Falls, Minn.

Stretching the Pollen Supply

R. Z. Callaham and J. W. Duffield

ALTHOUGH the pollen of pines and many other conifers is relatively easy to obtain in large quantities, circumstances may make it desirable to extend or dilute pollen. Among these are the need to make a large number of test crosses with the pollen of a single young tree, the wish to avoid repeated collections from a single remote tree, or the use of artificial mass pollination procedures similar to those used in modern fruit production.

Horticulturists have diluted their costly pollen with all manner of substitutes. These include such cheap, fine-grained substances as wheat starch, powdered milk, powdered charcoal, cornstarch, talc, and fuller's earth. Perhaps the pioneer in this field was L. H. MacDaniels (*9*). Of the many materials he tested, pear pollen diluted with *Lycopodium* spores gave highest fruit sets. More recent tests prove that pollen diluted with *Lycopodium* gives economical pollination of apples (*3, 10*) and of beech (*1*). One part viable pollen to 1 to 3 parts diluent did not seem to decrease the production of sound seeds.

Studies to make controlled pollination of pines more effective and more economical are part of the program of the Institute of Forest Genetics at Placerville, California. The first breeding trials using diluted pine pollen were made in 1946 and were extended in the 1957 breeding season. Seeds from these last crosses were harvested in 1958.

THE AUTHORS are chief, Div. of Forest Genetics Research, Institute of Forest Genetics, Pacific Southwest Forest and Range Expt. Sta., Forest Service, U. S. Dept. Agric., and technical director of the Industrial Forestry Association's Col. W. B. Greeley Nursery at Nisqually, Wash.

Procedure

In this preliminary work, we diluted viable pollen with dead pollen from *Pinus strobus* and *Pinus coulteri*. We had available an abundant supply of pine pollen which had lost its viability. We heat-treated the diluent pollen for 16 hours at 85° C. and subjected it to the Institute's standard germination test (*11*) to be certain it was not viable. Each of our fresh pollen samples was collected from trees in the Institute pinetum. Collection and extraction procedures followed Cumming and Righter (*4*). We then combined the fresh and dead pollens by weight, and stored the mixtures in a refrigerator. We used the diluted pollen a few days later to pollinate receptive conelets on bagged branches.

In 1946, we pollinated two *P. jeffreyi* trees with lots containing 100, 10, and 2 percent viable pollen. The live pollen was from a natural hybrid, *P. jeffreyi* × *P. coulteri* growing near Idyllwild in southern California, and the diluent was dead pollen of *Pinus strobus*.

In 1957, we made two series of crosses. We pollinated three *P. jeffreyi* trees with lots containing 100, 50, 20, 10, and 2 percent viable pollen. The pollen in this case was a mixture taken from five trees of the backcross hybrid *P. jeffreyi* × (Natural *P. jeffreyi* × *P. coulteri*). Three *P. ponderosa* trees received lots containing 100, 50, 20, 10, and 2 percent viable pollen. This pollen was collected from a single *P. engelmannii* growing on the Institute grounds. In both series, the diluent was dead pollen of *P. coulteri*.

We followed the procedures outlined by Cumming and Righter (*4*) to control pollination. We counted the cones from each cross, removed every seed from each cone, and separated sound from hollow seeds by winnowing. Finally, we calculated for each cross the yield of sound seeds as a percentage of total number of seeds.

Results and Discussion

The 1946 trials showed pollen dilution would work (Fig. 1). Even with only 2 percent of viable pollen in his syringe, a tree breeder can produce sound seed. In the 1957 trials, the planned series of 36 test crosses (5 pollen dilutions plus open pollinations on 3 trees of two species), yielded 23 lots of seed. The combined data for both trials (Fig. 1) were subjected to covariance analyses. For each tree the corrected sums of squares and cross products were calculated for the regression equations:

$$Y=a+b(VP)+c(VP)^2 \quad (1)$$

$$\text{arc sine } Y=a+b(\text{arc sine } VP)+c(\text{arc sine } VP)^2 \quad (2)$$

$$Y=a(VP)^b \quad (3)$$

where Y=yield of sound seed as a percent of the total seeds per cone, and VP=viable pollen as a percent of the total pollen lot.

The reduced sums of squares and cross products were added together for all trees regardless of species. "F" tests of these pooled data showed the regression coefficients for the independent variables in each equation to be significant at the 0.01 probability level. Tests were not made to find which of these equations provided the best fit to the raw data for 7 trees.

Typical curves representing these regression equations were developed (Fig. 2). Equations (1) and (2) gave maximum yields of sound seeds in the vicinity of 70 to 80 percent viable pollen; for simplicity, only single curves passing through the origin (a=0) are presented.

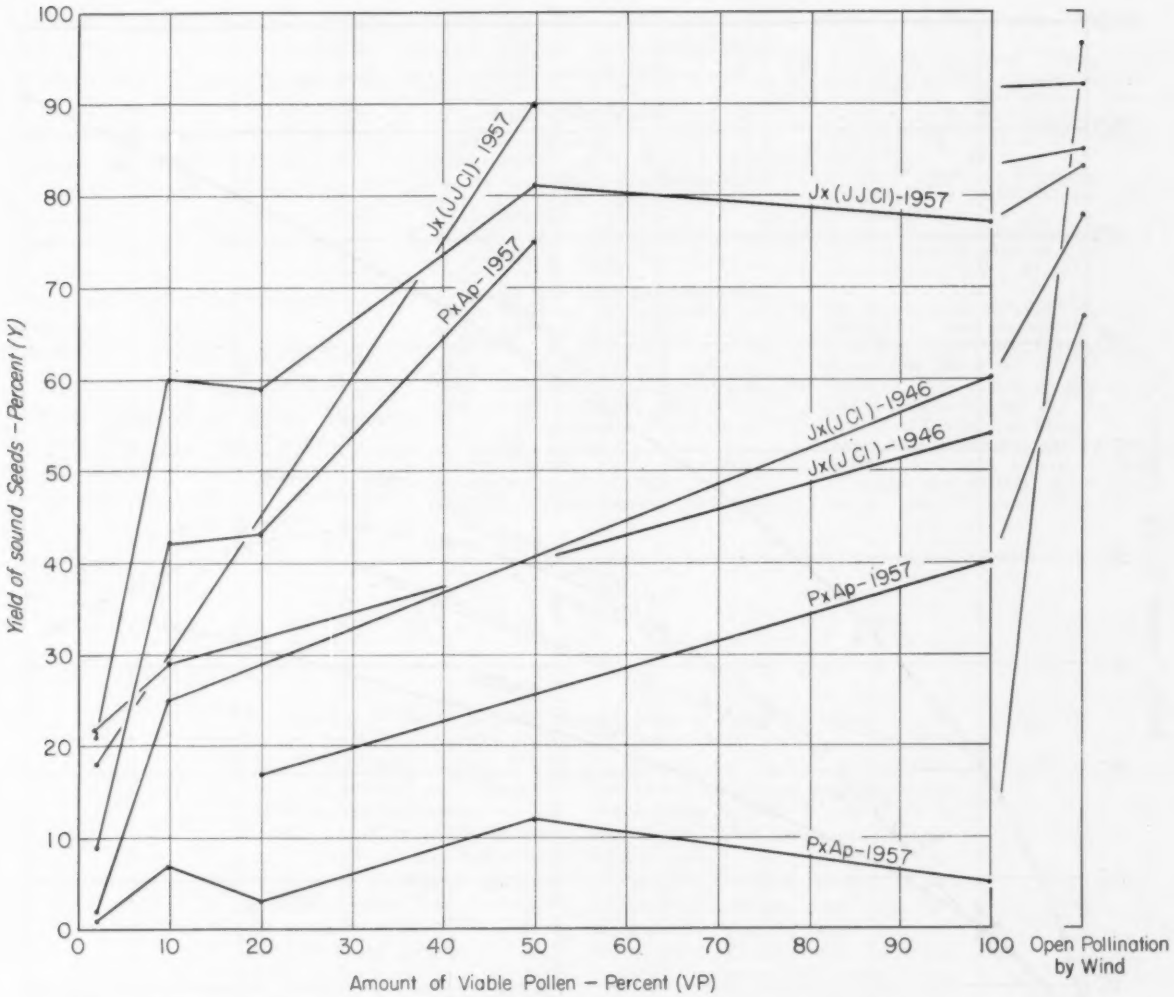


FIG. 1.—Proportion of total seeds that were sound when cones were open-pollinated or were control-pollinated with mixtures of live and dead pollen.

The exponential regression (3) provides a series of curves radiating from the origin to maximum values attained with 100 percent viable pollen.

The shape of these curves is suggestive. Curves based on equations (1) and (2) suggest that maximum seed sets might be obtained with other than pure viable pollen. In only two cases could 1:1 and 1:0 dilutions be compared. In both, the diluted pollen produced more viable seed. Do too many viable pollen grains inhibit development of all grains or preclude fertilization in some way? At the other extreme, Brink (2) and Kuhn (7) showed that a few pollen grains mutually stimulate pollen tube elongation, but tubes from isolated grains grow only very slowly. Where lies the optimum? More extensive tests are needed to clarify this vital point.

Now comes the problem of relative values. In one kind of research, a particular hybrid may be sought at any cost. If a breeder has only a precious amount of a valuable pollen, probably he should dilute it with 3 to 10 parts of dead pollen. More bags will have to be pollinated, but the highest total yield of sound seeds will result. In another phase of research, pollen may be abundant and cheap. In this instance, highest seed yield per man-hour of work may be most important. Here, a syringe full of 50 to 100 percent viable pollen would be most fruitful. Let us consider commercial mass-production of hybrids. Excessive pollen dilution would not be advisable unless pollen costs far exceed the remaining charges to control pollination. However, if further trials confirm that moderate dilutions do not significantly reduce seed yields, tree breeders would be foolish not to seize on such an opportunity to reduce the "stud fee."

Wind-pollinated check lots show the effects of controlling pollination. Nature's way was best in every case. Controlling pollina-

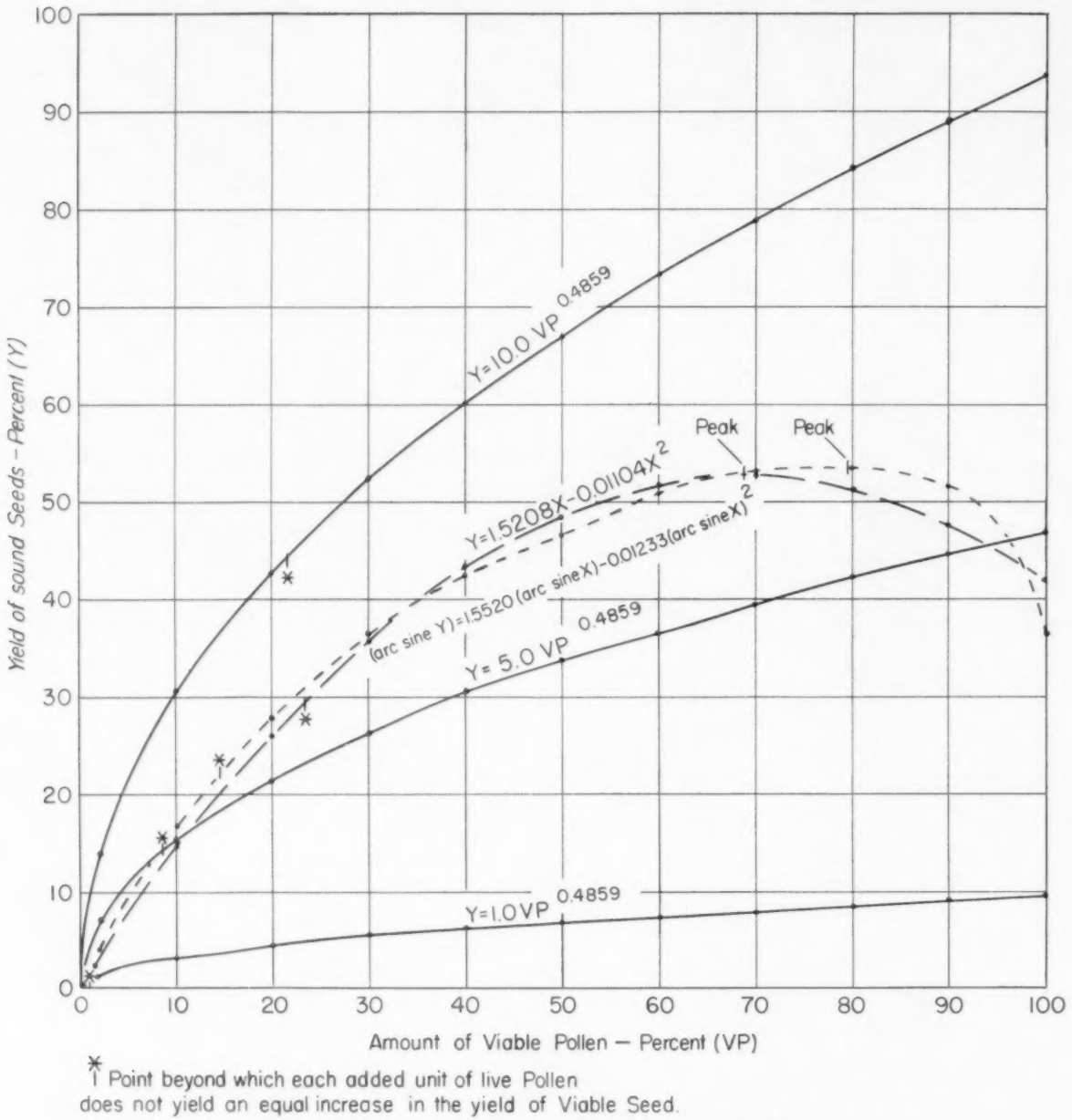

Yield of sound Seeds - Percent (Y)
Amount of Viable Pollen — Percent (VP)
Y=10.0 VP 0.4859
Y=1.5208X-0.01104X2
(arc sine Y)=1.5520(arc sineX)-.001233(arc sineX)2
Y= 5.0 VP 0.4859
Y=1.0VP 0.4859
Peak
Peak
* Point beyond which each added unit of live Pollen does not yield an equal increase in the yield of Viable Seed.

FIG. 2.—Theoretical yields of sound seed when viable pollen is diluted with dead pollen.

tion produced some sizable reductions in yield of sound seed in this series. Lest the wrong conclusion be drawn, however, numerous records are on hand at Placerville demonstrating seed set from control pollinations exceeding that from wind pollinations. In this case, ill-timed pollinations might be one cause. Incompatibilities between seed parent and either viable pollen or dead diluent might have complicated the problem further. This subject of pollination with pollen mixtures needs critical study.

Pollen dilution did not affect cone set. Diluted or pure viable pollen in the syringe gave about the same proportion of conelets maturing into cones. The data for all crosses gave:

Viable pollen (percent)	100	50	20	10	2
Conelets (number)	201	43	43	62	65
Cones (number)	91	20	19	36	28

Pollen dilution did not affect the total seed set per cone. However, this statement has less supporting evidence. No trends were discernible in the data at hand.

Summary

Cheaper pollen means cheaper mass-produced hybrid seeds. Extending viable pollen with diluents is one means of cutting pollen costs. A range of dilutions containing

100, 50, 10, and 2 percent viable pollen was used in controlled pollinations of *Pinus jeffreyi* and *P. ponderosa*. Fragmentary results indicate that diluting viable pollen with an equal amount of dead pollen may not cut production of viable seeds. In fact, greatest fertility of each unit of pollen might be achieved with only 10 to 30 percent viable pollen in the syringe. Neither the development of conelets to mature cones nor the total production of sound plus hollow seed was affected by pollen dilution. Wind-pollinations always produced more sound seeds than controlled pollinations; whether pollinations were ill-timed or whether species incompatibilities were present was not determined.

Literature Cited

1. BLINKENBERG, CHR., H. BRIX, M. SCHAFFLITZKY DE MUCKADELL, AND H. VEDEL. 1958. Controlled pollinations in *Fagus*. Silvae Genetica 7(4):116-122.
2. BRINK, R. A. 1924. The physiology of pollen. IV. Amer. Jour. Bot. 11: 417-436.
3. BULLOCK, R. M., AND F. L. OVERLEY. 1949. Handling and application of pollen to fruit trees. Proc. Amer. Soc. Hort. Sci. 54: 125-132.
4. CUMMING, W. C., AND F. I. RIGHTER. 1948. Methods used to control pollination of pines in the Sierra Nevada of California. U. S. Dept. Agric. Circ. 792. 18 pp. Illus.
5. FOREST SERVICE. 1958. Commercial production starts for hybrid pines. In 1957 Annual Report, California Forest and Range Expt. Sta. pp. 22-23.
6. HYUN, S. K. 1956. Forest tree breeding work in Korea. Central Forest Expt. Sta., Suwon, Korea Institute of Forest Genetics, Paper No. 1, 19 pp. + 14 plates. English translation, 16 pp.
7. KUHN, E. 1937. Zur Physiologie der Pollenkeimung bei Matthiola. Planta 27: 304-333.
8. LIBBY, W. J. 1958. The backcross hybrid Jeffrey x (Jeffrey x Coulter) pine. Jour. Forestry 56 (11): 840-842.
9. MACDANIELS, L. H. 1930. The possibilities of hand pollination in the orchard on a commercial scale. Proc. Amer. Soc. Hort. Sci. 27: 370-373.
10. OVERLEY, F. L. AND R. M. BULLOCK. 1947. Pollen diluents and application of pollen to tree fruits. Proc. Amer. Soc. Hort. Sci. 49: 163-169.
11. RIGHTER, F. I. 1939. A simple method of making germination tests of pine pollen. Jour. Forestry 37:574-576.

All categories of forest products—roundwood, sawnwood, plywood, particle board, woodpulp, newsprint, other paper, paperboard and fibreboard—reached new record production levels in 1959, according to statistics released by the Food and Agriculture Organization of the United Nations.

The timber harvest from the world's forests reached 1,718 million cubic meters in 1959, an increase of 3 percent from the previous year and over 20 percent from the 1950 level. The wood destined for industrial use increased nearly 6 percent from the 1958 figure and over 37 percent from the removals recorded in 1950.

With figures from 156 countries, including estimates for mainland China, the FAO *Yearbook of Forest Products Statistics, 1960,* compiled in collaboration with the U.N. Economic Commission for Europe, gives a comprehensive picture of the tremendous development that is taking place in the forest industries in all regions of the world.

The *1960 Yearbook* contains, in addition to production, trade and consumption statistics, figures on land and forest areas of the world, the latest monetary exchange rates, forest product definitions and conversion factors. The salient features of the production, trade and consumption developments are described in text and summary tables in three languages—English, French and Spanish. The main features of the forest products situation are shown in two-color charts.

Notes and Observations

Progress with Direct Bark Inoculation for White Pine Blister Rust

Various methods are used in the search for blister rust resistant strains of eastern white pine. Rust-free trees growing in heavily infected stands are often selected and seedlings or grafts made from them are tested for resistance. Generally, testing involves planting the selections in areas where numerous infected *Ribes* bushes are present and where microenvironmental conditions favor spread of infection. In some cases, artificial inoculation is attempted by fastening leaves of infected *Ribes* onto the white pine. If inoculation is successful, several years must pass before the disease is evident. Until a canker appears, it is difficult to determine whether inoculation has actually occurred. Consequently, most workers believe that trees must be under test for 10 to 15 years or more. Means of shortening this test period and increasing the certainty of inoculation are being sought. In this study, the use of cankered bark containing active rust mycelium as a source of inoculum was investigated.

In the first attempts, a diamond-shaped piece of healthy bark, ½ by ¾ inches, was removed from the mainstem of the test tree and replaced with a diamond-shaped piece of cankered bark. The patch grafts were made in early June and were bound with plastic budding strips. These attempts were not successful; the patches soon withered and were replaced by callus tissue.

In the second attempt, an entire ring of cankered bark was used as inoculum. A cutting tool consisting of two thin steel blades placed parallel, ½ inch apart, followed by a guide arm to insure even contact, was used to outline the band of bark. This was then incised to the xylem with a sharp razor blade. The band was then gently peeled off with the back of a knife blade. The band was immediately inserted in place of a similar band removed from the mainstem of the test tree, several inches above the ground line. The bark graft was bound with rubber budding strips, applied diagonally to insure uniform pressure and firm contact between the edges of the band and the incised tree bark. Six to 9-year-old white pines were used, some already infected with blister rust. These trees were growing on a white pine—white spruce site at the Quetico-Superior Wilderness Research Center, Basswood Lake, Ely, Minn. The grafts were made in early June, and the budding strips were removed in late August.

Twenty-five inoculations were made during 1957 and 1958. Fourteen of these transmitted the disease and caused canker formation on the test trees. Seven trees died because of girdling caused by graft failure. In the remaining

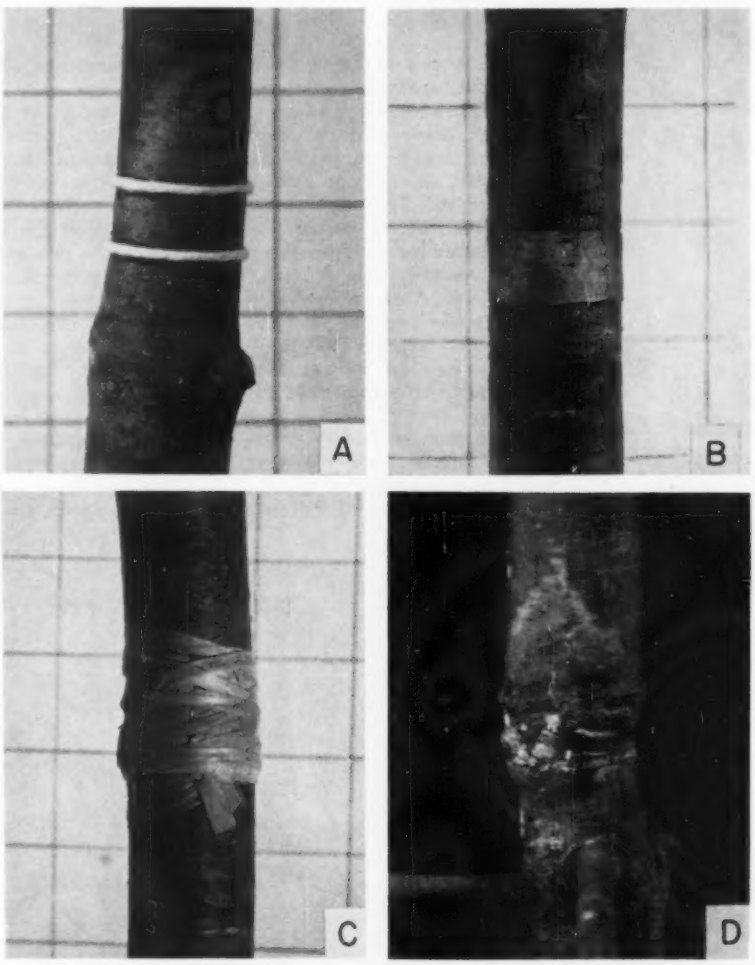


FIG. 1.—Steps in artificial bark inoculation: *A* Cankered stem, showing band of bark to be used as source of inoculum. *B* Bark band inserted into healthy stem. *C* Completed graft. *D* 1-year old inoculation showing spread of canker.

four, the disease is not spreading beyond the band of inoculum, although the grafts were successful.

The portion of the canker from which the inoculation band was obtained was a determining factor in graft survival. When the band was taken from the oldest, center portion of the canker, insufficient healthy tissue was present for good graft union and the inoculation band died causing girdling of the test trees, as occurred in seven trials. The most successful inoculations occurred when the band came from near the tip of the canker where mycelium was actively growing and a portion of the band was still healthy and uninfected.

Disease was transmitted both upward and downward from the inoculum, but was more rapidly spread in an upward direction. Incipient infection was noted on some grafts 2½ to 3 months after inoculation and was evident on all successful inoculations within one year after grafting. New cankers first appeared faint yellow, later attaining the characteristic color and shape of the normal canker. Pycnia were produced 14 months after grafting.

In two cases, development of the transmitted canker was slower, and a brown, corky barrier formed at the canker margin. Similar cases in trees inoculated from *Ribes* bushes have been interpreted as indications of resistance.[1]

Four successful bark grafts show no transmission of the disease. In all of these, the disease symptoms have disappeared from the grafted band. At present, there is no way of determining whether these cases represent another degree of resistance or whether the fungus disappeared from the band for other reasons. All four trees are completely disease free thus far.

Blister rust resistance in white pine is believed to be under polygenic control. In addition to the different degrees of resistance in the bark,[1] a distinction between needle resistance and bark resistance has been made.[2] The technique here described would be of use in testing for bark resistance. When the degree of reliability is further defined, however, this technique could shorten the time necessary to determine resistance and improve on the validity of present methods. Further tests are planned to determine the reliability of transmission on various parts of the mainstem and branches of known susceptible trees.

CLIFFORD E. AHLGREN
Quetico-Superior Wilderness Research Center, Ely, Minn.

[1]Struckmeyer, B. E., and A. J. Riker. Wound periderm formation in white pine trees resistant to blister rust. Phytopath. 41(3): 276-281. 1951.

[2]Bingham, R. T., A. E. Squillace, and J. W. Duffield. Breeding blister rust resistant western white pine. Jour. Forestry 51: 163-168. 1953.

Toxic Effects of A Fire Fighting Chemical

In recent years boron compounds—particularly sodium calcium borate—have been used with considerable success in fighting forest fires. Now a word of warning is needed about the damage that may be done to forest stands or other vegetation by the indiscriminate, careless, or honestly miscalculated use of borate.

Toxic Properties

Though it is essential in microamounts for plant growth, the element boron is toxic even at low concentrations. Very sensitive plants can tolerate only 1 part per million in solution, and for most plants the tolerable maximum is 4 or 5 parts per million.[1]

Because of its toxic properties, borate compounds are marketed under various trade names as herbicides and soil sterilants. In reporting tests of sodium calcium borate applied with ground equipment in fire control work, Miller[2] observed that 10 to 15 pounds of borate per 100 square feet killed the vegetation and prevented reestablishment of many species for at least 1 year.

Fahnestock[3] also has pointed out the undesirable toxic effects upon vegetation—young pines in particular—when borate was applied with ground equipment in constructing fire lines.

And it is well known from experience in the herbicidal use of borate that, at recommended dosages, it will kill practically all kinds of plants—from herbs to large trees.

Result Of A Fire Drop

For purposes of fire control, borate is applied to the vegetation and ground fuel as a thick slurry. Although borate slurries may be applied with ground equipment, they are used most effectively—and most dramatically—by dropping from aerial tankers.

In September 1958 a fire fighting demonstration on the Beltsville Experimental Forest in Maryland included an aerial drop of sodium borate slurry onto a hot fire in slash accumulated from a Virginia pine seed-tree cutting.

A converted TBM air tanker made two drops of 450 gallons each, from slightly above tree-top height. Though one drop missed the fire, the other was effective in retarding the fire. But the main point of interest was the secondary after-effect on the vegetation.

An area roughly 50 to 300 feet was liberally plastered with the slurry. Pine seed trees, smaller hardwoods, and ground vegetation were all well coated. Twelve months later all Virginia pine seed trees—17 of them—and most of the smaller pines within the drop area had died. The seed trees averaged about 11 inches d.b.h. and were from 60 to 75 feet tall.

Ground vegetation, principally low-bush blueberry, was almost completely eliminated over much of the drop area. Most of the small oaks and a few other hardwoods within the area still were alive, although some had discolored foliage. Additional mortality may yet occur among these hardwoods.

[1]Eaton, Frank M. Boron in soils and irrigation waters and its effects on plants. U. S. Dept. Agric. Tech Bul. 448. 131 pp. Illus. 1935.

[2]Miller, Harry R. Sodium calcium borate as a fire retardant: a progress report. U. S. Forest Service Fire Control Notes 17(4): 25-28. 1956.

[3]Fahnestock, George R. Borate firelines toxic to southern vegetation. Southern Forest Expt. Sta. Southern Forestry Notes 118. 1958.

The possible loss of a few ordinary forest trees is a minor consideration where a borate drop on a fire may save many acres of timber and countless man- and equipment-hours. However, there are situations in which a misdirected drop might do as much damage as the fire itself, for example, in Christmas tree plantings, seed orchards, and valuable experimental areas.

In such cases, as a general rule, reliance should be placed upon prompt application of standard fire fighting techniques; and an aerial drop of borate should be ordered only as a last resort when ground crews are unable to get control of the fire.

RICHARD H. FENTON
Northeastern Forest Expt. Sta., Forest Service, U. S. Dept. Agric., Laurel, Md.

A Technique for Germinating Pollen of Sugar Maple

For testing pollen viability and for cytogenic study of generative cell nuclei, proper germination techniques are required. The technique reported here was made use of in a study of sugar maple (*Acer saccharum* Marsh.) pollen, one of the initial phases of a hardwood tree-improvement research program being carried on at Burlington, Vermont.

The pollen used was collected from flowers of mature sugar maples growing in the vicinity of Burlington. The basic technique followed was to plate out the pollen on sugar agar in moist chambers in the conventional manner.

Two sizes of pollen grain were noted in the pollen obtained both from male flowers and from anther sacs of functional female flowers, the latter dehiscing in a few instances under greenhouse conditions. The larger grains were characterized by thin walls, the smaller by thicker walls. For both sizes the contents of the grains were similar in appearance. Twenty-five percent or more of the grains from both types of flowers were empty or had disorganized contents.

Consideration was given in this study to (1) initiation of pollen germination, (2) maintenance of normal pollen-tube growth, and (3) prevention of premature bursting of pollen tubes.

Observations on rate of germination of pollen grains indicated that sugar concentrations of 0.40 to 0.45 molar were optimal. But pollen-tube lengths thus obtained did not exceed 135 microns prior to bursting, and only a minority of the pollen grains produced tubes.

In efforts both to initiate germination and to prolong tube growth, pollen was treated with lipase, boron, and calcium. The use of lipase was empirical, based on its assumed action upon possible oil reserves in the ungerminated pollen grain. Boron was used because extensive literature indicates that for some species a very low concentration of boron in sugar agar is necessary for pollen germination. However, recent research indicates that in certain genera boron is necessary for continuation of pollen-tube growth rather than initiation of germination. And it is well known that the calcium ion has a favorable effect on preservation of the gel state in protoplasm and thus in the case of pollen tubes may serve to prevent premature bursting.

Initial treatment of pollen grains with crude lipase at concentrations of 0.005 percent gave a maximum range in tube lengths of 235 to 300 microns in 4 hours before bursting. This small increase in length over the 135 microns or less that were obtained without treatment may be due to impurities in the lipase rather than to the lipase itself. The addition of a few crystals of boric acid to the basic sugar-agar medium, with or without minute amounts of calcium carbonate, yielded normal-appearing pollen tubes from thinner walled grains. These tubes attained lengths of 700 to 900 microns before bursting.

In all germination attempted, the larger and thinner walled grains consistently emitted the tubes first. Later a smaller percentage of thicker walled and smaller grains emitted shorter tubes.

Although the maximum tube lengths obtained were short compared to lengths attained on stigmas and styles *in vivo*, it is possible that divisions in the generative cell nuclei may have advanced sufficiently for cytogenetic study. However, this study has been deferred until a later date.

A. GERSHOY
and W. J. GABRIEL
Geneticists, Vermont Agric. Expt. Sta., and Northeastern Forest Expt. Sta., Forest Service, U. S. Dept. Agric.

The Effect of Gibberellin on the Germination Rate of Eastern White Pine

The germination period of stratified white pine (*Pinus strobus* L.) seed averages between 45 and 60 days and the percentage of seed germinated is rather low under field conditions. For these reasons it may be that a growth-promoting substance such as gibberellin may, as a result of its action on the seed coat and embryo, take the place of stratification and increase the rate of germination and also the percentage of germinating seed.

Very little work has been done to stimulate germination of forest tree seed although in recent years more investigators have been working with growth responses on tree seedlings. Seed dormancy of certain tree species can be broken using gibberellic acid. Donoho and Walker (*1*) stated that the germination of peach seeds was hastened by soaking in gibberellin solutions of 100 and 200 parts per million. Seeds of races which need light for germination also germinate with gibberellic acid in darkness as shown by Lona (*3*). Gray (*2*) stated that the seeds of some plants which were coated with a gibberellic acid slurry emerged

faster and grew taller than seedlings from untreated seeds. The speed and capability of germination of *Pinus strobus* and *Picea abies* seeds are not improved by a 12-hour soak in 10 or 25 p.p.m. gibberellic acid nor by longer influence of these solutions (*4*).

Procedure

The experiment, using white pine seed of the 1959 cone crop gathered at the Yale Forest, Keene, N. H., was initiated October 12, 1959, and ran for 45 days. Treatments consisted of 12, 24, 48 and 96 hour soaks in concentrations of 100, 500, and 1,000 parts per million of gibberellic acid and controls soaked in distilled water. A randomized block design of 16 treatments each with two replications consumed a total of 2,400 seeds. Lots of 50 white pine seeds (unstratified) per treatment were immersed in the solutions for soak periods of 12, 24, 48, and 96 hours per concentration.

Forty-eight petrie dishes, with covers, were aligned randomly upon a bench located in an air-conditioned chamber with a constant day temperature of 72°F. and a night temperature of 65°F. Each dish contained 50 white pine seeds on a medium of double filter paper saturated with distilled water when drying of the medium occurred. Daily germination counts were recorded to determine which combinations of time and concentrations produced the most significant germination percentage. Germination was taken to mean that point at which the radicle has emerged from the embryo and is distinctly visible.

Discussion

There was a significant increase in the germination means of both the gibberellic acid treatments and the time treatments. There was, however, a greater increase in the means of the time treatments inferring that the time element had the greatest effect on the germination of the seeds.

In the 12-hour time treatment the germination percentage increased from the control (0) to the 100 p.p.m. concentration and then gradually decreased as the concentration increased. The 24-hour time treatment decreased germination in a straight line from the control to the maximum concentration of 1,000 p.p.m. The 96-hour treatment proved to be very erratic in its mean germination trend.

The 1,000 p.p.m. concentration had a detrimental effect on the germination rate of white pine seed regardless of time treatment.

Comparing the mean percentage of germination of each treatment, the germination mean of the control treatment increased the most between the 12 and 24-hour time periods. There was an actual decrease in germination between the 24 and 48-hour time periods which is approaching the magnitude of the increase between the 12 and 24-hour time periods. There was a very slight increase in germination between the 48 and 96-hour time periods. In the 500 p.p.m. concentration the greatest increase occurred in the 24 to 48-hour time period. Little increase was noted between the 12 and 24-hour time periods as in the 100 p.p.m. concentration; however, there was a considerable decrease between the 48 and 96-hour time periods. The 1,000 p.p.m. concentration decreased the germination rate decidedly from 12 to 24 hours, but increased again by almost 20 percent in the period 24 to 48 hours.

These results indicate that the increase in germination was greatest between the 24 and 48-hour time periods using concentrations of gibberellic acid of 100 and 500 p.p.m. A greater percentage of seedlings emerged using gibberellic acid than emerged using distilled water.

There was no apparent difference between treatments within the first two-week germination period. However, a significance level of five percent was approached in the interaction of time and concentration.

The increase in germination was not in general great enough at this point to warrant the expense and time involved in soaking eastern white pine seed in gibberellic acid for field sowing.

Literature Cited

1. DONOHO, C. W., and D. R. WALKER. 1957. The effect of gibberellic acid on breaking the rest period of Elberta peach. Science 126: 1178-1179.
2. GRAY, R. A. 1957. Alterations of leaf size and shape and other changes caused by gibberellins in plants. Amer. Jour. Bot. 44: 674-682.
3. LONA, F. 1956. Gibberellic acid induces germination of seeds of *Lactuca scariola* in the dark-inhibition phase. Chem. Abstr. 51: 1382. 1957.
4. PFNUR, E. 1957. The effect of gibberellic acid on seed germination. Source Book on Gibberellin-Stodola (ed.) U. S. Dept. Agric. 1958.

MELVIN E. JENKINS
Department of Forestry, University of New Hampshire, Durham

University of Arizona Watershed Management Department

The establishment of the Department of Watershed Management in the College of Agriculture at the University of Arizona was authorized by the Board of Regents in 1958. A grant of $100,000 from the Charles Lathrop Pack Forestry Foundation aided its establishment.

The department is one of 59 degree-granting departments in 11 colleges with an enrollment of over 12,000 full-time students. Strong support for the curricula in watershed management comes from the liberal arts and basic science education programs of these departments. The programs in watershed management are strengthened also by four recognized and cooperating research groups: The Laboratory for Tree-Ring Research, The Institute of Water Utilization, The Institute for Atmospheric Physics, and the Cooperative Wildlife Research Unit.

The department is engaged in teaching at both the undergraduate and graduate levels and in research through the Agricultural Experiment Station. Coursework is offered under two curricula: watershed management and range management.

The new curriculum in watershed management is a basic forestry curriculum with strong emphasis on the underlying sci-

UNIVERSITY OF ARIZONA Watershed Management Faculty. *Left to right:* R. F. Wagle, assistant professor; D. G. Wilson, associate professor; Barry N. Freeman, extension specialist; Oren Duane Knipe, assistant in research; Philip N. Knorr, associate professor; Percy B. Rowe, associate professor; Jorge Morello, visiting professor, Tucuman University, Argentina; Rayden A. Perry, visiting research scholar, Australia; R. R. Humphrey, professor; A. L. McComb, head of department and professor. Not in photograph: Louis P. Hamilton, manager, Plant Materials Center; Ervin M. Schmutz, instructor; Charles W. Ferguson, research associate.

ences. It is flexible enough to permit a minimum of specialization in forest production or management, watershed management, and forest and watershed science. The University has offered two or three courses in forestry over a period of more than 24 years. Students completing the watershed management curriculum meet the requirements for membership in the Society of American Foresters and for Civil Service forester examinations. Range management and wildlife management are available as minors.

Range management has been offered as a major since 1934. Prior thereto, subjects in this field had been offered since 1930 as a curriculum in range ecology with supporting work in animal husbandry. Wildlife management, animal science, and forestry are available as minors. Currently there are two visiting scholars, Dr. Jorge Morello from Tucuman University in Argentina, and Mr. Rayden Perry, Commonwealth Scientific and Industrial Research Organization, Australia.

The faculty of the Department of Watershed Management (see photo) consists of 10 men, seven with both teaching and research duties, two who teach courses offered in the department but have other duties in allied departments, and an extension specialist. The faculty divides its time equally between teaching and research on an alternate semester basis. The department is responsible for the operation of the University's Plant Materials Center, with a staff of four. In addition, there is a research associate, two assistants in research, three graduate teaching assistants, five graduate research assistants, a predoctoral National Science Foundation fellow, and a Pack Foundation fellow.

A varied research program in range management covering the ecology of range plants, shrub invasion of range lands, control of noxious plants and range reseeding, and production problems has been in existence for a number of years. New research programs in forestry and watershed management have been started within the last two years. These programs relate to the hydrologic cycle as affected by vegetation and to the ecology, silviculture, and management of second-growth ponderosa pine. The forested University land grant lands, totalling some 36,000 acres, are available for research and summer field instruction. Lands administered by the Forest Service, Bureau of Indian Affairs, and Bureau of Land Management are used for cooperative research and for instruction.

The B.S., M.S. and Ph.D. degrees, the last under the Plant Science Graduate Program, are available in both watershed and range management.

Slope or Flat Pruning of Pines—An Important Consideration in Christmas Tree Plantation Management[1]

The number of terminals or leaders that develop on pines after pruning influences the development and form of the trees. If more than one leader develops, the stem of a tree will often show a pronounced crook, even after all but one terminal has been removed in subsequent shearing operations. According to Christmas tree grading standards set up by the U. S. Department of Agriculture Marketing Service, crooks in stems of trees constitute either "minor" or "noticeable" deformities, depending on severity. Such deformities can reduce tree quality and grade and may thereby reduce the sale price.

After pruning pines, a large number of adventitious buds form at the base of needle fascicles (Fig. 1), usually near the tips of the cut stems. One or more of these will produce upright limbs which will assume the position of the new terminal or terminals. In many instances none of the limbs that form after pruning is able to exert dominance, and several branches may turn upward. It is often impossible to select one suitable limb to serve as the terminal, and the development of the Christmas tree may be ruined completely.

The purposes of this study were to test two commonly used methods of cutting the terminal stems of pines and to determine their effects on the number of leaders which developed after pruning.

Procedure

Scotch pine (*Pinus sylvestris* L.) and red pine (*Pinus resinosa* Ait.) were pruned using two methods of cutting the terminal leaders of the trees. As shown in Figure 2, one method consisted of cutting the terminal at an angle of approximately 45° (slope-pruned) to the main axis of the tree, while in the second method the cut was made at an angle of 90° (flat-pruned), as is shown in Figure 3.

During the summer of 1957, experiments were conducted at two locations, Reedsville and Bruceton Mills, in Preston County, W. Va. At each location, 60 trees of each species were slope-pruned and 18 trees of each species were flat-pruned. Only the Reedsville location was used in the summer of 1958; 50 trees of each species were slope-pruned, 15 were flat-pruned, and 60 trees of each species were left as unpruned controls.

One year after pruning, the trees were checked and the number of terminals that developed on each tree was counted.

Results

Statistical tests indicate that results from prunings at the two locations (Bruceton Mills and Reedsville) in 1957 are essentially the same. Tests further indicate that there are no significant differences between results from the 1957 and 1958 prunings at Reedsville. For these reasons, the data have been summarized by species and type of pruning and the combined data used as the basis for further comparisons. A summary of results is contained in Table 1.

Scotch pine.—Slope-pruning and flat-pruning brought about highly significant increases in both number of terminals and percentage of trees having multiple leaders. The average of 1.27 terminals per tree which formed after slope-pruning represented an increase of 21 percent over the unpruned controls. For flat-pruned trees, the average was 2.54 leaders, an increase of 142 percent over unpruned trees. Slope-

[1]Published with the approval of the director, West Virginia Agricultural Experiment Station as Scientific Paper No. 626.

FIG. 1.—New buds forming at the bases of needle fascicles on a pruned Scotch pine terminal.

FIG. 2.—Slope-pruned terminal of a Scotch pine. Note that the cut has been made at an angle of approximately 45 degrees to the main axis of the tree, leaving at the apex of the stem one needle bundle which is well above the other needle bundles.

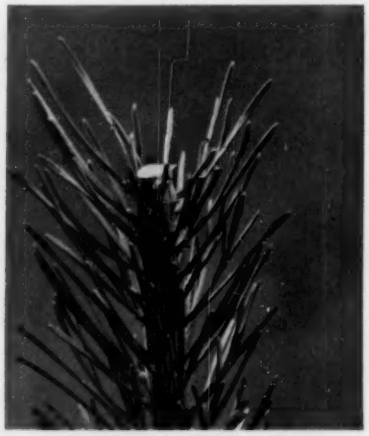


FIG. 3.—Flat-pruned terminal of a Scotch pine. Note that the cut has been made at an angle of 90 degrees to the main axis of the tree, leaving several needle bundles equally close to the cut edge.

TABLE 1.—SUMMARY OF RESULTS: EFFECTS OF TYPE OF PRUNING ON DEVELOPMENT OF TERMINALS ON RED AND SCOTCH PINE

Type of pruning	Year pruned	Location	No. trees	Terminals per tree Average	Trees with multiple leaders Percent
Scotch pine					
Control	.....	Reedsville	60	1.05	5.0
Slope	1957	Bruceton Mills	60	1.29	27.1
Slope	1957	Reedsville	60	1.30	23.3
Slope	1958	Reedsville	50	1.22	22.0
Averages for slope-pruned Scotch pine				1.27	24.9
Flat	1957	Bruceton Mills	18	2.53	76.5
Flat	1957	Reedsville	18	2.61	72.2
Flat	1958	Reedsville	15	2.47	73.3
Averages for flat-pruned Scotch pine				2.54	74.0
Red pine					
Control	.....	Reedsville	60	1.07	6.7
Slope	1957	Bruceton Mills	60	1.40	34.5
Slope	1957	Reedsville	60	1.30	30.0
Slope	1958	Reedsville	50	1.28	28.0
Averages for slope-pruned Red pine				1.31	31.2
Flat	1957	Bruceton Mills	18	2.67	88.9
Flat	1957	Reedsville	18	2.56	94.4
Flat	1958	Reedsville	15	2.47	86.7
Averages for flat-pruned Red pine				2.57	90.0

pruned Scotch pine had from 1 to 3 leaders per tree, while flat-pruned trees had from 1 to 6 leaders. Twenty-five percent of the slope-pruned and 74 percent of the flat-pruned trees had two or more terminals. For flat-pruned trees, the average of 2.54 leaders per tree and 74 percent of trees having multiple leaders were found to be significantly greater than the corresponding values for slope-pruned trees (1. 27 leaders per tree and 25 percent having multiple leaders).

Red pine.—Highly significant increases in number of leaders per tree and proportion of trees having multiple leaders were associated with both slope- and flat-pruning. As indicated in Table 1, an average of 1.31 terminals were formed after slope-pruning, as compared with 2.57 per tree after flat-pruning. These averages represent increases of 22 and 140 percent, respectively, over the average of 1.07 leaders on unpruned controls. Slope-pruned red pine had from 1 to 3 terminals, with 31 percent having two or more. In comparison, flat-pruned trees had from 1 to 4 leaders, with 90 percent having two or more. It was found that the 2.57 terminals per tree and 90 percent of trees having multiple leaders that resulted after flat-pruning were significantly greater than the corresponding values obtained on slope-pruned trees (1.31 terminals per tree and 31 percent with multiple leaders).

FIG. 4.—Single leader which formed on a slope-pruned Scotch pine. The tree was pruned approximately one year prior to the time this photo was taken.

FIG. 5.—Two leaders which formed on a flat-pruned Scotch pine. Note that the leaders are forming a V, with neither being directly in line with the axis of the tree. It is quite likely that this tree will continue to show a crook even after one of the terminals has been removed.

Discussion

When one of the newly formed buds on a pruned stem is located at a point above the other buds, the shoot from that bud usually develops into the new terminal. The remaining buds elongate into lateral branches. Thus, slope-pruning commonly results in a single bud above the others and produces fewer trees with multiple leaders than does flat-pruning. As may be seen in Figure 2, one needle bundle on this slope-pruned tree is located near the apex of the pruned stem and is definitely above the other needles on the stem. The shoot that develops from the bud in this needle fascicle will probably become the new leader. A slope-pruned tree which developed one leader is shown in Figure 4. On the other hand, observe the flat-pruned tree in Figure 3. There are several needle bundles which are equally close to the cut edge on this stem. When new buds develop, no particular one will have an advantage over the others. Because of this it is likely that more than one of the new shoots will turn upward, and the tree will develop multiple leaders. A flat-pruned tree with multiple leaders is shown in Figure 5.

This should emphasize the importance of careful pruning of pines in Christmas tree plantation management. By making the cut on the terminal at an angle (preferably 45° or more), the number of leaders that develop and the proportion of trees having multiple leaders will be greatly reduced. Thus, the number of crooked trees will be less, and the quality and value of the Christmas trees will be increased.

JAMES H. BROWN
West Virginia University
Morgantown

Points of View

An Example of Group Action for Multiple Use

Society of American Foresters
Washington, D. C.

Gentlemen:

The owners of timberlands along the Allagash River in the State of Maine have for many years managed their lands to protect the natural resources of the State and to lend stability to the wood-using industries.

During all this time, and as a result of these forward-looking policies, the wilderness nature of the Area has been preserved and has provided superb recreational values for Boy Scouts, Campers, Canoers, and Sportsmen generally.

We are proud of the role we have played in serving the State's economy while protecting the natural wonders of the beautiful Allagash Area for the enjoyment of the public.

Those of us who share the majority of the landownership along the Allagash have decided, therefore, to reaffirm our policy regarding this Area and to publish the attached statement on multiple use which has long been our guide in the Area. As this is a matter of considerable interest and importance to the people and industries of Maine, I am pleased on behalf of the landowners, to forward this statement to you.

Very truly yours,

INTERNATIONAL PAPER CO.
DEPARTMENT OF WOODLANDS
/s/ MORRIS R. WING
Resident Manager

Allagash Land Management Policy

The owners of timberlands through which the Allagash River flows have followed a policy which has preserved the natural scenic value of the waterway while producing a continuous supply of timber. This policy has provided for the economic and recreational needs of the state, and will continue to provide multiple use benefits for the people of Maine.

The timberland owners are agreed that they will:

1. Grow and harvest forest products in the area in accordance with sound forest management policy.
2. Preserve the natural wilderness beauty of land bordering on lakes and water courses, and the canoeing tradition of the famous Allagash River.
3. Continue the policy of public use of the area for recreational purposes, but strictly limit the construction of buildings along the waterway.
4. Protect the forest from fire, insects, and disease, working through the Maine Forestry District in accordance with Maine law.
5. Cooperate with the Department of Inland Fisheries and Game to encourage the wise management and use of fish and wildlife resources.
6. Continue to work on long range plans for increased recreational use of the area compatible with the growth and harvest of timber.

❦❦❦

Further Notes on the Color Description of Foliage

In a recent article[1] I urged that in foliage description "standard color references be more widely employed, and that a single standard such as the Munsell system (coupled with the I.S.C.C.-N.B.S. names where needed) be adopted by the forestry profession, and that observation conditions be agreed upon." Dr. White in commenting on this article[2] has raised the following objections:

1. There is difficulty in describing the range of color which may exist in one leaf or a group of leaves.
2. The reliability and workability of the Munsell system in describing plant tissue has not been demonstrated.
3. Tests which he conducted with several groups of forestry students using color designations "were not too encouraging."

Additional comments on these objections seem warranted if we are to make any progress toward more meaningful color designation in forestry.

Dr. Hamly has already commented on the first objection raised by White by pointing out that centroid values and observed deviations from it may be used to denote color range.[3] I certainly agree with White that color differences between leaf margin and petiole, upper and lower needle surface, tip and base of needle, are substantial, but fail to see why the use of standard color references to describe these is not an an improvement on our present ambiguous color words. Is it not more precise to report that in trees damaged by herbicides, the needle tips are 2.5 GY: 8/6 to 2.5 GY: 7/8 and the upper surface mid-points are 7.5 GY: 6/4 to 10.0 GY: 7/8, rather than saying the tips are greenish-yellow and the mid-points gray-green? For "normal" foliage, color measurements can be made at some standardized location on the leaf. In a cooperative Scotch pine study involving Cornell, Pennsylvania State, and Rutgers Universities, we have agreed to take color measurements one-third of the distance from the needle tip, and use the average of all surfaces at that point.

I cannot agree with Dr. White's

[1]Hamilton, Lawrence S. Color standardization for foliage description in forestry. Jour. Forestry 58:23-25. 1960.

[2]White, Donald P. Comments on "Color standardization for foliage description in forestry." Jour. Forestry 58:325. 1960.

[3]Hamly, D. H. Comment on color description of foliage. Jour. Forestry 58: 810. 1960.

second objection, for there does exist proof of the reliability of the Munsell system. In the first place, it has been shown by Nickerson that independent observers in color matching both hay and cotton samples with Munsell colors exhibit remarkable agreement.[4] In one of the tests, she reports the greatest average disparity between two observers measuring 12 series of 25 cotton samples each (the same samples) was 0.036 for value and 0.090 for chroma. Another test demonstrates the ability of the same observers to duplicate readings several weeks apart on their original samples. Dr. White is undoubtedly aware of the agreement which is possible between two observers in designating soil samples. Nickerson[5] reports that on 250 soil samples, two observers made independent judgments with an average difference in notation of 0.6 ± 0.8 hue, 0.2 ± 0.2 value, and 0.3 ± 0.4 chroma. Comparisons between visual Munsell readings and spectrophotometric measurements have shown strong correlation. Gerhold's visual Munsell judgment as a basis for determining chlorophyll a and b accounted for 88 percent of the variation and his measurements showed a correlation of .938.[6] I have just completed an analysis of measurements which Gerhold carried out in connection with our cooperative regional project on Scotch pine. He measured 30 needles of each of 46 seedlots with a Bausch and Lamb Spectronic 20 colorimeter (with reflectance attachment) and by visual Munsell notation. The correlation coefficient for these measurements was —.8075.

One is at a loss to explain the results which White obtained with his students, if the observation conditions were standardized, and if the students had been previously tested for color vision problems. Certainly the adoption of the Munsell system by the American Horticultural Council, American Orchid Society, American Society for Testing Materials, its use in the grading of agricultural products by the United States Department of Agriculture, and its use in the Soil Survey and in soils work in general, suggest that White's "not too encouraging results" should not dissuade us from tentatively adopting the Munsell system.

White's comments do suggest a major difficulty in describing foliage color, unrelated to any system of color designation; namely the psychological color difference between the total mass of tree foliage and the color of any specimen of leaf or needle taken from it. Originally when designating colors for bales of hay, the bale was spun to give a composite color. Thus it is that the needle color of a Colorado blue spruce (one-third distance from tip, average of all surfaces) designated as 2.5 G 5/4 fails entirely to suggest the over-all "blue" appearance of this tree as an ornamental specimen. Perhaps the color psychologists can help us out on this problem.

In summary, I feel that we now have sufficient indication of the reliability and practicality of the Munsell Color System to warrant its use in an area where fuzzy and even meaningless description now prevails. The problems which White raises are largely those of standardizing observation methods, and describing the location on the tree or on the leaf where the color measurement was taken, and are not failings of the Munsell color notation.

LAWRENCE S. HAMILTON
Cornell University
Ithaca, N. Y.

[4]Nickerson, Dorothy. Application of color measurement in the grading of agricultural products. U. S. Dept. Agric. Prelim. Report. Washington, D. C. 36 pp. Illus. 1932.

[5]———. Color measurement and its application to the grading of agricultural products. U. S. Dept. Agric. Misc. Pub. 580. Washington, D. C. 62 pp. Illus. 1946.

[6]Gerhold, H. D. Seasonal variation of chloroplast pigments and nutrient elements in the needles of geographic races of Scotch pine. Silvae Genetica 8, Heft 4, 113-123. July-August 1959.

Grazing and Multiple Use

We would like to take issue with the article "Comments on 'Multiple Use'," which appeared in the JOURNAL OF FORESTRY, Volume 58, page 975 (December 1960).

It is assumed that the authors are professional foresters, but their viewpoints on land management seem amazingly limited. It is obvious that they know little of land management in a multiple-use program as practiced in much of America. We are truly surprised at their attitude toward the domestic cow. Their comment about the presence of a cow on the official seal of the Fifth World Forestry Congress, which was an acknowledgment of range forage as a resource and grazing as a land use, shows they have limited experience in the broader aspect of land management. Apparently these individuals do not object to grazing by big game animals because on the seal opposite the grazing cow is a big game animal. It appears that these professional foresters have an aversion to domestic livestock grazing but not to grazing by big game, despite the fact that cows are less apt to graze upon trees than are game animals.

Most of the timbered lands in the West produce highly valuable forage as well as timber, and produce livestock gains equivalent to or even better than fattening rations in farm feed lots.

It may be a surprise to professional foresters of the Lakes States, but professional land managers in the West, including foresters, are committed to the belief that forestry and grazing are to a large extent compatible and that both have a place in multiple-use planning.

It seems a bit narrow minded to believe that the whole world should have the same evaluations of grazing forested lands as some of the hardwood foresters of Wisconsin. It might be that the laughs made by foreign foresters when viewing grazing on timbered lands mentioned in the comments of Messrs. Medvick and Robert were not at the multiple use but rather at the odd American foresters themselves, who "inadvertantly" let them see a cow!

The authors make clear their

concept that "managing a forest" has timber yield as a sole objective and that "intensive" management would eliminate other forest uses and products. Apparently, they follow an amazingly narrow concept of multiple land use which suggests that "range land within the boundary of a forest" should be grazed but not the "forest." Is this multiple use or is it in reality segregation of use? Is it possible that these men honestly believe that, the minute trees appear in the flora, range ceases to be range and that it now becomes a "forest" that as such is inviolate to uses other than wood production? It is generous indeed of the authors to admit that "the majority of foresters are willing to concede the fact that there are other land uses besides forestry." It is time that foresters become land managers and put wood in its proper place as only one of the many products of land.

Multiple use does not imply maximization of each use or of any one use. The concept, rather, is that by integrated uses of many kinds, the sum total of production will exceed that possible by any one use alone. Timber production is no exception. Even where some sacrifice of maximum wood production is involved, still production of both meat and wood on the same land may exceed that of either alone.

Lands of the West have long been managed under multiple-use principles. Renewable resources such as water, forage, timber, and wildlife need to be used; otherwise they are wasted. A multiple-use program integrates the resource uses into a plan where all are used wisely, but seldom does one use completely exclude any of the others.

It is reasonable to assume that certain timbered lands may need to be protected during certain stages of development; but where forage is produced as an understory it would not seem wise to make a rule of thumb that no grazing is ever to be permitted on the mere supposition that the trees might possibly be damaged in some manner. If such thinking were to prevail, it would be deleterious to the livestock industry of the West where millions of acres of timbered lands are now grazed.

There is much literature to suggest that not only are some forests not damaged by grazing but that proper grazing actually benefits tree growth. It is suggested that professional foresters read the article by Campbell (*1*) concerning the Southern forests where grazing is used as a silvicultural tool. Likewise, some grazing was found conducive to good timber management in the Northwest (*6*). In the hardwood forests of the Ozarks grazing can be fit into management of commercial hardwood forests (*3*). In the Southwest there are over 10 million acres of sawtimber forests and practically the entire forested area is grazed by domestic livestock. In most areas of this region grazing and other land uses can be fitted profitably into an integrated management plan (*5*).

In California, timber cutting, in many cases, is practiced in order to encourage a greater supply of forage for livestock; thus the lands serve not only as an important commercial timber source but also furnish badly needed summer forage for the livestock industry (*2*).

In the Rocky Mountain area nearly all of the timbered areas are grazed by livestock. It is acknowledged that uncontrolled grazing affects reproduction of certain timbered types adversely, but proper management of livestock is not detrimental to commercial sawtimber forests and, in many cases, is actually beneficial (*4, 7, 8*).

References

1. CAMPBELL, R. S. 1954. Integration of grazing and timber production in the deep South. Proc. Soc. of Amer. Foresters.
2. HORMAY, A. L. 1947. Forest grazing in California. Proc. Soc. Amer. Foresters.
3. HORNKOHL, LEON W., and RALPH A. READ. 1947. Forest grazing in the Ozarks. Proc. Soc. Amer. Foresters.
4. MORRIS, MELVIN S. 1947. The grazing use of forest lands in the northern Rocky Mountain Region. Proc. Soc. Amer. Foresters.
5. PARKER, KENNETH W. 1947. Forest grazing in the Southwest. Proc. Soc. Amer. Foresters.
6. RUMMELL, ROBERT S. 1951. Some effects of livestock grazing on ponderosa pine forests and range in central Washington. Ecology. 32:594-607.
7. SMITH, A. D., and L. A. STODDART, 1947. Range lands and livestock operations of the Intermountain and Central Rocky Mountain Region. Proc. Soc. Amer. Foresters.
8. YOUNG, V. A., G. B. DOLL, B. A. HARRIS, and J. P. BLAISDELL. 1942. The influence of sheep grazing on coniferous reproduction and forage on cut-over western white pine areas in northern Idaho. Univ. of Idaho Bul. 37(6).

C. WAYNE COOK
Research professor
and L. A. STODDART
Head, Range Management Dept., Utah State University, Logan

Correction

In the September 1960 JOURNAL OF FORESTRY an article by Stoddard and Geltz "Technical Training for Nonprofessional Field Personnel in Forestry and Conservation" stated that the National School of Forestry and Conservation (a home study-resident vocational training school) "has been fully accredited by the Department of Public Instruction of Wisconsin under standards considered the most rigorous in the United States." The authors wish to correct the name of the educational approving agency from that given above to the Governor's Educational Advisory Committee which is not a part of the Department of Public Instruction. The authority of National Home Study Council is given as the source of the statement on rigor of Wisconsin's standards.

CHARLES H. STODDARD

Book Reviews

Biology and Control of the Western Pine Beetle: A Summary of the First Fifty Years of Research

By J. M. Miller and F. P. Keen. (Misc. Publ. 800. U. S. Dept. Agric.) Government Printing Office, Washington 25, D.C. 381 pp. Illus. $2.25.

Although the western pine beetle (*Dendroctonus brevicomis* LeC) was first recognized as a distinct species 84 years ago—by Dr. John L. LeConte—it was not until lumbering and forest management became serious activities at the turn of the century that it came to be regarded as a pest of such serious proportions as to upset logging plans and handicap forest management. Its "capacity to destroy large volumes of valuable timber" and that it "was hastening exhaustion of the old stands" brought it concentrated attention by timber owners, foresters, and entomologists. In about 1900, Dr. A. D. Hopkins first recognized the beetle's importance. Promptly thereafter, 1902, the Bureau of Entomology set up an office of Forest Insect Investigations. The western pine beetle has since been a subject of intensive and profound studies. The results of these studies have been, in most part, available only in reports.

This monograph reviews, summarizes, and ties together the results of the studies of the authors and their many associates from a formidable list of 152 publications and 346 office reports. Even with the familiarity of the authors with the contents of these documents it was no inconsiderable task to dig out and analyze the significant facts and prepare them in an orderly flowing style.

The studies here reported are brought up to 1952. A few years before, Mr. Miller was retired from the Bureau of Entomology and Plant Quarantine. Mr. Keen took up the job upon Miller's death in 1952, and was himself retired from government service in 1955. The Bureau was transferred to the U. S. Forest Service in 1953.

There is no index to this book of 354 pages of text, and none is needed. The table of contents is extraordinarily complete and orderly.

The book is in five sections. Section I on biology, seasonal history, and habits, discusses such details of life history as the methods of attack including the character of bark selected, location of first attacks, density of attack, duration of attack, group attacks, sex making initial attack, mating habits and number of beetles per attack. Skipping down the list we find other characteristics, some apparently insignificant, such as noise of construction, ventilation holes, number of eggs per female, food habits of the larva, micro-organisms associated with the larvae, temperature and moisture requirements, light, air, odors, and many others, all necessary to know if the entomologist is to have full understanding of the behavior of his insect enemy and where and how he can be attacked.

Section II covers biotic relationships of the insect—population potential; normal brood mortality in flight and in the galleries and factors causing it, such as temperature, nutritional deficiencies, competition, parasites and predators. In this section are treated also the insects associated with the western pine beetle in making attacks.

Section III on relations between beetles and host trees is a prelude to the sections on control measures. In it are described the reactions of an attacked tree, from such immediate ones as "pitching out," to growth functions and finally death. It includes time to kill a tree; the role of micro-organisms —blue stain fungi and yeasts; the deterioration of beetle-killed trees; host tree resistance and susceptibility; tree classifications; relation to silvicultural and environmental conditions, and special environmental hazards.

Section IV deals with beetle surveys. On this subject the authors have done pioneer work that is a valuable guide to others engaged in controlling large-scale insect epidemics. Among the subheads are historical surveys; survey methods; methods of area coverage; factors affecting loss estimates; spotting for control; and, finally, planning and reporting bark beetle surveys.

Section V quite naturally is the final product—control methods and strategy. This is a 75-page chapter beginning with the early method of felling, peeling and burning, and going through later methods of burning or other disposal of infested material. Other direct methods include the use of solar heat and spraying with toxic oils. Even such ineffective methods as scoring felled trunks, electrocution, radio waves and fumigation are included. The techniques of control covered include such methods as trapping, logging infested trees, and the effect of logging practice. The possibilities of biological control and the use of preventive measures are discussed as well as indirect or silvicultural control and, finally, control policy.

In the course of the many investigations a number of control projects were set up in cooperation with public and private owners, mostly in Oregon and California. How these were set up, what was done and what was accomplished, are reported. These projects revealed the many factors that needed further study. Many "blind alleys" were explored and there were many failures, but there were also substantial successes that offer guides for future effective control measures for other insect pests.

The authors would be quick to disclaim sole credit for the vast amount of work that preceded the studies written up in the 346 office reports that had to be re-analyzed for significant data. Their associates prepared a very large part of

them. For example, J. N. Bomberg prepared 15; R. C. Hall, 14; K. A. Salman, 33; G. R. Struble, 23; J. E. Patterson 18, and H. L. Person, 17, to list only the principal contributors. Miller himself wrote 26 and co-authored 8 others, while Keen wrote 42 and co-authored 4. Such a long list of reports indicates, from their titles, how thoroughly each possible avenue to control measures was explored. There are 27 pages listing the 152 published and 346 office report materials cited in the text, themselves a valuable source of reference for future researchers.

Tree classification deserves a further note. The researchers learned that certain specimens of ponderosa pine are more susceptible to infestation by the western pine beetle than others and that they can be identified by their age and crown vigor. The outcome was the "Keen tree classes," an expansion of the earlier Dunning tree classification for silvicultural purposes. The Keen classification is based on a study of 49,701 beetle-killed trees in Oregon and California, compared with 64,159 green trees. Later, a scheme of "risk rating" was evolved based on tree crown characteristics as a visible manifestation of current health. The four "Risk Classes" are now widely used by public and private owners in planning logging. They provide the basis for a system of salvage logging that has proved outstandingly successful. This, in fact, is the culmination and seems to be the answer to the western pine beetle problem. All that goes before shows the futility of any method of destroying the beetles and ignoring the trees. Obviously the beetle attack is secondary to tree condition. Given weak trees there is bound to be beetle depredation. Healthy timber successfully resists it. It took 52 years of research and many thousands of dollars to find out that good forest management is the answer. With this solution the beetle problem seems to be licked.

The book is a milestone in American forestry. It exemplifies the vast amount of scientific and practical information that still needs to be gained to realize America's forestry hopes. It is a tribute also to the two men who, even after their retirement, felt obligated to summarize and make available the results of their many years of devoted study and pioneering.

Emanuel Fritz

❦❦❦

The Development of Site Concepts at the Harvard Forest and Their Impact upon Management Policy

By John C. Goodlett. 128 pp. Bulletin No. 28. Harvard Forest, Petersham, Mass. 1960. $0.50.

Can observations in natural stands yield sufficient generalizations to enable foresters to prescribe successful practices for managed stands, or must actual trials of a wide range of practices be evaluated? This case history of a 50-year research effort reflects on that important question.

The initial third of the bulletin recounts the unsuccessful efforts on the Harvard Forest, beginning in 1908, to regenerate almost pure stands of white pine by clearcutting or shelterwood. Generally accepted observations of native white pine in stands of the Northeast up to that time had yielded the conclusions that this species grew best in mixtures with hardwoods, was "shade tolerant," and made rapid height growth after 5 to 8 years to outgrow any hardwoods with which it might be in competition. Even for pines threatened with suppression by hardwoods, hand release was confidently recommended. Experimental cuttings at Petersham yielded adequate stands of pine regeneration. Nevertheless, the ultimate results were quite contrary to expectation, as is told succinctly by Goodlett:

"An inventory of the forested lands (on the Harvard Forest) in 1908 showed a total of 10.5 million board feet of merchantable timber, about 10 million of which was white pine (p. 13). . . . In the 1930's most of the white pine experiments on the uplands were recognized as definite failures. White pine was virtually absent from the mixed hardwood stands in spite of repeated cultural treatments" (p. 8).

In searching for explanation of their discouraging results, the Harvard foresters turned to intensive study of site. First came a long and probably necessary detour into site deterioration under pure pine stands. Then the researchers redirected site investigation to increasingly more detailed examination of soil evolution, micro-relief, surface drainage and relief, subsurface compacted layers, ground water levels, and soil morphology as an indicator of moisture availability. Presumably this phase has been directed toward describing relationships of soil to species composition of hardwood stands, such relationships to be useful in shaping management policy. One may ask if the same pattern of fifty years before is not being followed in trying to deduce programs for actively managed stands from observations of a few factors in stands where this same degree of management intensity is not being carried out.

Although the author does not state a conclusion in these terms, a reader is tempted to infer that site is a conditioning rather than a critical factor in stand composition, at least for the range of sites under study, and that many other factors such as weather, past land use, fire, and variations in seed years may be more dominant influences. Since these factors may continue to introduce uncertainty into management programs, especially where natural regeneration is sought, an effort to apply a minutely detailed site classification as basis for a management program may be of little value, though it may help the forester in silvicultural decisions as he moves from tree to tree.

The publication is a reminder that the forest manager must consider site in two senses: its significance in the (1) growth rate of established trees and stands, and (2) in the case of getting new stands started. "Good site" in one sense is not always "good" in the other, and overlooking either may

upset an otherwise sound management program.

Goodlett, and with him the long line of research foresters on the Harvard Forest, deserve recognition for making possible this frank exposition of the entire sequence of a research program. Forestry research needs such perspectives. The bulletin will be rewarding to all who are interested in site classification and its use in management, and to those concerned with obtaining coordination between research and field practice.

O. F. HALL
Purdue University, Lafayette, Ind.

❦❦❦

Photogrammetry and Photo-Interpretation (2nd edition of Aerial Photographs in Forestry)

By Stephen H. Spurr. 472 pp. Illus. The Ronald Press Company, New York. 1960. $12.

Any forester who uses aerial photographs to map forest areas and inventory large tracts of timber should own this book, read it thoroughly and consult it frequently. Professor Spurr clearly presents to forest photogrammetrists and photo interpreters the pertinent information contained in his two earlier books, *Aerial Photographs in Forestry* and *Forest Inventory*. In addition he effectively summarizes the voluminous literature in this field, most of which has been published since his earlier books were printed. Furthermore, this edition contains valuable details, lacking in the earlier edition, regarding such fundamental tasks as (1) orienting two overlapping photographs for stereoscopic study, (2) preparing a radial line plot for use in map control, and (3) allocating field plots and photo plots when estimating timber volumes photogrammetrically.

A few deficiencies contained in the first edition have not been rectified. For example, readers will justifiably continue to complain that the nearly full-page diagram purporting to show the effect of focal length upon displacement is virtually meaningless. Many users of Spurr's first edition will continue to wish for more photographic illustrations, particularly in stereogram form, to augment statements made in the text. The reader also will note some unfortunate mathematical and textual errors, as when relating tree height to shadow length or summarizing that "most stand aerial volume tables utilize tree height and crown diameter as independent variables." Nevertheless, in this reviewer's opinion Professor Spurr's new book is the most complete and best written text available for foresters concerned with the use of aerial photographs in the mapping and inventorying of large tracts of timber.

Unfortunately, the author had no intention of limiting his reading audience to such a specialized group. He indicates in the preface that this second edition is intended to serve all nonphotogrammetrists who use aerial photographs as a professional tool, be they foresters, geologists, soil scientists, botanists, geographers, or engineers. The unqualified title *Photogrammetry and Photo-Interpretation* is in keeping with this broad objective. Herein lies the only serious weakness of the book. For in his effort to make the book appealing to many, the author limits its usefulness to all. To illustrate: The author rightly points out that it is in the preparation of management plans and in the routine management of tracts by foresters that photo interpretation is destined to reach its greatest applications in forestry. Despite this fact, he devotes less than two pages to the use of photos in fire protection, range management, wildlife management, and forest recreation, even though he acknowledges that the forester ordinarily is responsible for these important aspects of forest management. Had the author elaborated on these aspects, perhaps by deleting the twelve pages on "Human Activities and Structures," he would have greatly increased the usefulness of the book to forest managers, but he would still further have disenchanted the nonforester, attracted to this book by its broad title and by the broad claims made in its preface.

Critics are a common commodity, but authors of Professor Spurr's ability are rare, indeed. I will welcome this book as a required text for my course in forest photogrammetry and photo interpretation.

ROBERT N. COLWELL
University of California, Berkeley

❦❦❦

Land, Wood and Water

By Robert S. Kerr. 380 pp. Illus. Fleet Publishing Corporation, New York. 1960. $4.95.

As Senator Kerr points out in the preface, this book is intended for the layman rather than the technician. It is written in semi-autobiographical style. The title "Land, Wood and Water" is credited to the author's pioneer father who migrated from Texas to the then Indian Territory in 1894 in search of these resources. The slogan has served the Senator well in three successive campaigns for the U. S. Senate.

While much of the background material comes from the hearings conducted by the Select Committee on Water Resources, of which Kerr was chairman, ancient history, the Bible, and personal experiences are drawn upon to build a rich, comprehensive and readable coverage of the problem.

Major emphasis is on water—water for domestic and industrial use, for recreation, for irrigation, for navigation. The wastage of water and the losses of resources and lives by floods is dramatically covered. Chapter headings, "A Bowl of Water," "Gruel from the Taps," and "Floating Garbage Cans," indicate the Senator's concern about growing water shortages and the pollution of important supplies.

Forestry is covered principally from the standpoint of the importance of forested watersheds as the chapter title, "A Wooden Barricade" indicates. The Davis County, Utah, project is reported upon as is the work at Coweeta. Recognition is given to the progress made by industrial and federal

forestry programs and the problem of small ownerships is observed. The necessity of adequate timber supplies and the need for stepped up planting programs is noted. This chapter closes with the following observation: "The intriguing question is whether we will do this naturally, or wait until a tragic shortage faces us, and the western watershed is so stripped that floods and dry faucets follow like night after day."

The Senator's concern with land problems can be expressed by two quotations, "Probably the most wasteful instrument ever devised by man is the bulldozer," and "We may need some kind of zoning to hold good soil from the spread of cities and factories." (Some of the critics of his flood control and navigation proposals will be quick to point out the loss of valuable agricultural soils to flooding and upstream siltation.)

From the standpoint of political philosophy the Senator prefers the interagency cooperative approach as exemplified by the Arkansas, Red and White Basin study to the single agency approach as exemplified by T.V.A., although he gives effective praise to the accomplishments of this latter organization.

Historians will find much interesting detail on the thinking, planning, trials and tribulations of the individuals and groups that have had a part in the development of water resources policy in the Southwest. The forester concerned with multiple use will also find much of interest. Those concerned with public policy will want to read it carefully. It is important that they understand the Senator's thinking in regard to natural resources. His influence in this field, because of his interest, his long study and his position on important committees, will be felt for many years to come.

Glen R. Durrell
Oklahoma State University, Stillwater

❦❦❦

The Nature and Properties of Soils

By Harry O. Buckman and Nyle C. Brady. 6th ed. 567 pp. Illus. The Macmillan Company, New York. 1960. $7.95.

As a classic work this book has been a standard text for students of soils for almost 40 years. In 21 chapters the authors, both of the Agronomy Department of Cornell University, present in logical sequence an introduction to soil science. Only the last three chapters treat directly with soil management problems although examples from agricultural practice are used throughout the text.

A cursory examination of this new edition may leave the impression that very little has been changed from the 1952 revision. Chapter and section headings are usually the same and general size and format are almost identical. However, on closer inspection, the careful reader will discover significant changes, additions, and deletions in recognition of new knowledge and concepts in soil science.

The most important additions are a brand new chapter on the micro or trace nutrients and more complete coverage on soil survey interpretation and land classification. Sections on soil-water relations, soil acidity, and soil parent materials have also been extensively revised. On the other hand some chapters like the one on the Organisms of the Soil are virtually unchanged.

The authors have followed their previous arrangement of setting more technical material for the advanced reader in smaller type thereby permitting the general reader to skip easily over the more difficult portions. One welcome change is the reduction in the number of footnotes from the previous edition. For example, in the previous edition, Chapter 3 had 50 footnotes. In the new edition, these have been cut to 16 without any important loss in documentation for the careful reader. A number of excellent new photographs have also been added. By judicious use of bold face type and subheadings the text may be easily scanned as a reference work. In a number of cases difficult concepts have been presented clearly by the use of diagrams. Examples to the point are the movement of water through the soil and the technique of measuring soil moisture by the "neutron-scattering" method.

This text will continue to be one of the standard works for beginning students, and foresters will find the basic principles applicable to their problems as well as to those of the agronomist. In either case, the authors assume a background knowledge of physics, general chemistry, and geology.

What is lacking is any treatment or reference to the special problems of the forest manager, i.e. soil-site evaluation, nursery soil problems. Special subjects of particular interest to foresters such as the mycorrhizal function in tree nutrition have been treated very briefly and with no revision from the old edition.

Although somewhat oriented to the East by virtue of the authors' experience, it is by no means a "regional text" and should continue to receive countrywide acceptance.

Donald P. White
Michigan State University, East Lansing

❦❦❦

Publication of Interest

The growing role of aircraft in the fight against forest fires is graphically portrayed in a new booklet, "Air Attack on Forest Fires," issued by the U. S. Department of Agriculture.

The history of aircraft as a fire fighting tool, from the first use for fire detection by General H. H. "Hap" Arnold in 1919, is summarized in the attractive publication.

The 32-page illustrated booklet describes development of aircraft for detection, cargo delivery, smokejumping, delivery of retardants, rescue, and other related work.

Current Literature

Compiled by LOIS MCALLISTER, *Assistant Librarian, State University College of Forestry at Syracuse University*
Range Management Section Compiled by NELLIE G. LARSON, *Library, U. S. Department of Agriculture*

General

American Forestry; Six Decades of Growth. Edited by Henry Clepper and Arthur B. Meyer. 319 pp. Society of American Foresters, Mills Bldg., Washington 6, D. C. 1960. $5.

A Checklist for Planning and Conducting Forestry Demonstration Meetings. By C. L. Olive. 5 pp. Tennessee Valley Authority, Div. of Forestry Relations, Norris. 1960.

Loblolly Pine; Its Use, Ecology, Regeneration, Protection, Growth and Management. By W. G. Wahlenberg. 603 pp. Illus. Duke University School of Forestry, Durham, N. C. 1960. $7.

Switzerland and Its Forests; a Synthesis of Middle-European Forestry Ideas. By Fritz Fischer. 56 pp. Illus. Oregon State College School of Forestry, Corvallis. 1960.

Forest Economics

The Demand and Price Situation for Forest Products. By U. S. Forest Service, and Commodity Stabilization Service. 39 pp. Illus. U. S. Department of Agriculture, Washington 25, D. C. 1960.

Statistics on Tropical Timber, 1958. 102 pp. Organization for European Economic Cooperation, Paris. 1960. Available from O.E.E.C. Mission, 1346 Connecticut Ave., N.W., Washington 6, D. C. $1.

Forest Genetics

Minimum Standards for Progeny-Testing Southern Forest Trees for Seed-Certification Purposes. By P. C. Wakeley and Others. 20 pp. Southern Forest Expt. Sta., New Orleans 13, La. 1960. Committee on Southern Forest Tree Improvement Sponsored Pub. No. 20.

Forest Management

Identifying Southern Forest Types on Aerial Photographs. By Gene Avery. 10 pp. Illus. Southeastern Forest Expt. Sta., Asheville, N. C. 1960. Sta. Paper No. 112.

Keen's Tree Classification and Marking Rules for Ponderosa Pine in B.C. 4th ed. 8 pp. Tables, diagrams. British Columbia Forest Service, Management Div., Victoria. 1960. B.C. Forest Service Pub. No. T26.

Methods of Measurement and Volume Calculation for Exotic Conifers. By G. Duff. 18 pp. Tables. New Zealand Forest Service, P.O. Box 894, Wellington. 1960. Forest Research Inst. Tech. Paper No. 29.

Normal Yield Tables for Red Alder. By N. P. Worthington and Others. 29 pp. Tables, charts. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1960. Research Paper No. 36.

Land Use

Utah's Federal Grant Lands. By A. D. Smith. 28 pp. Illus. Utah Agric. Expt. Sta., Logan. 1960. Special Report No. 14.

Logging and Milling

Effect of Better Log Making on Tree Value. By W. W. King. 7 pp. Tables. Tennessee Valley Authority, Div. of Forestry Relations, Norris. 1960. Tech. Note No. 33.

Logging Road Handbook; the Effect of Road Design on Hauling Costs. By J. J. Byrne. 65 pp. Illus. U. S. Department of Agriculture, Washington 25, D. C. 1960. Agric. Handbook No. 183.

The Malayan Grading Rules for Sawn Hardwood Timber. 85 pp. Illus. Federation of Malaya, Forest Dept., Kuala Lumpur. 1960. $2.

A Test of Skyline Cable Logging on Steep Slopes—a Progress Report. By F. R. Herman. 17 pp. Illus. Rocky Mountain Forest and Range Expt. Sta., Fort Collins, Colo. 1960. Sta. Paper No. 53.

Pathology

Diseases and Pests of Ornamental Plants. 3d ed. By P. P. Pirone, B. O. Dodge, and H. W. Rickett. 775 pp. Illus. Ronald Press, New York 10, N. Y. 1960. $10.

Dry Face of Naval Stores Pines. By C. S. Schopmeyer and O. C. Maloy. 7 pp. Illus. U. S. Forest Service, Washington 25, D. C. 1960. Forest Pest Leaflet No. 51.

List of Common Names of Fungi Attacking Indian Forest Trees, Timber and the Herbaceous and Shrubby Undergrowth and List of Cultures of Forest Fungi. By K. Bagchee and Ujagar Singh. pp. 199-348. Table. Manager of Publications, Delhi, India. 1960. Indian Forest Records (New Series): Mycology, v.1, no. 10. 18s.

Protection

European Pine Shoot Moth Damage As Related to Red Pine Growth. By H. J. Heikkenen and W. E. Miller. 12 pp. Illus. Lake States Forest Expt. Sta., St. Paul, Minn. 1960. Sta. Paper No. 83.

Research Report, 1956-1959, Entomology Research Institute for Biological Control, Belleville, Ontario. 45 pp. Maps. Canada Department of Agriculture, Research Branch, Ottawa. 1960. Available from Information Div., Canada Department of Agriculture.

Silviculture

Comparative Growth of Eight Conifers in a Plantation in Mahoning County, Ohio. By John Aughanbaugh. 14 pp. Tables, charts. Ohio Agric. Expt. Sta., Wooster. 1960. Special Cir. No. 96.

A Field Test of Dunemann Stock. By R. E. Mullin and R. H. Leech. 25 pp. Tables. Ontario Department of Lands and Forests, Research Branch, Ottawa. Canada. 1959. Research Report No. 41.

Second-Growth Western White Pine Stands; Site index . . ., Normality Percentage Trends, Mortality. By R. F. Watt. 60 pp. Illus. U. S. Department of Agriculture, Washington 25, D. C. 1960. Tech. Bul. No. 1226. 25 cents (Govt. Print. Off.)

Wildlife Management

Manual of Game Investigational Techniques. Edited by H. S. Mosby. 355 pp. Illus. 1960. Available from The Wildlife Society, c/o Virginia Cooperative Wildlife Research Unit, Department of Forestry and Wildlife, Blacksburg, Va. $4.50.

The Small Mammals of Otsego and Schoharie Counties, New York. By P. F. Connor. 84 pp. Illus. State Education Dept., New York State Museum and Science Service, Albany. 1960. Bul. No. 382.

Wood Technology and Utilization

Drying Stresses and Stress Relief in Thin Sections of Wood. By Hans Kuebler. 35 pp. Illus. U. S. Forest Products Lab., Madison 5, Wis. 1960. Report No. 2164.

Indentificarea Lemnului. By N. G. Ghelmeziu and P. N. Suciu. 397 pp. Illus. Editura Technica, Bucuresti, Romania. 1959. Lei 49, 60.

Some Effects of Repeated Drying and Wetting on Wood Properties. By C. T. Keith. 16 pp. Illus. Forest Products Laboratories of Canada, Department of Forestry, Ottawa. 1960. F.P.L. Tech. Note No. 23.

Society Affairs

Officers and Council
1960-1961

CHARLES A. CONNAUGHTON, *President*
U. S. Forest Service
630 Sansome Street
San Francisco 11, Calif.

B. E. ALLEN
Union Bag-Camp Paper Corp.
P. O. Box 570
Savannah, Ga.

WILLIAM C. BRAMBLE
Department of Forestry and Conservation
Purdue University
Lafayette, Ind.

DONALD E. CLARK
U. S. Forest Service
Federal Center, Building 85
Denver 7, Colo.

HENRY J. MALSBERGER, *Vice President*
Southern Pulpwood Conservation Association
900 Peachtree Street, N.E.
Atlanta 9, Ga.

KENNETH P. DAVIS
School of Natural Resources
University of Michigan
Ann Arbor, Mich.

GEORGE A. GARRATT
School of Forestry
Yale University
New Haven 11, Conn.

WILLIAM D. HAGENSTEIN
Industrial Forestry Association
1410 S.W. Morrison Street
Portland 5, Ore.

HENRY CLEPPER, *Executive Secretary*
Mills Building, 17th Street at Pennsylvania Avenue, N.W.
Washington 6, D. C.

SVEND O. HEIBERG
College of Forestry
State University of New York
Syracuse 10, N. Y.

RICHARD J. PRESTON, JR.
School of Forestry
North Carolina State College
Raleigh, N. C.

CHARLES L. TEBBE
U. S. Forest Service
Federal Building
Missoula, Mont.

Second Call for Council Nominations

All members are hereby notified that the regular biennial election will be held December 2, 1961. A president, vice president, and nine other members of the Council will be elected for the two-year term 1962-1963.

The present Council is listed in the box above. Any or all of these incumbents may be renominated, provided they accept the nomination in writing.

Membership on the Council is restricted by the Constitution to Members (formerly Senior Members) and Fellows. Any Member or Fellow is eligible to hold office who is in good standing and who accepts the nomination in writing and declares his willingness to serve if elected.

Each voter will have an opportunity to ballot on all candidates for office. Council members are elected in accordance with the system of proportional representation. The procedure of proportional representation will be explained in a later issue of the JOURNAL. It is the system by which the Society has been electing Council members for more than two decades.

Candidates for the office of president are voted on separately; the candidate who receives the highest vote is declared elected president, and the candidate who receives the next highest vote is declared elected vice president. Thus all candidates for president are considred as nominated also for vice president.

How Nominations Are Made

The Constitution (Article VIII, Section 2) states the conditions under which nominations are made by petition.

1. Each petition shall name but one candidate.

2. All candidates must be eligible to hold elective office.

3. A petition shall bear the signatures of at least ten voting members who at the time of signing the petition are eligible to vote in the coming election. (Eligible voting members are Junior Members, Members, and Fellows in good standing.)

4. A voting member may not sign more than one nominating petition for president or more than one nominating petition for a member of the Council. That is, he may sign two, but no more.

5. Petitions must be in the Society office by September 16, 1961.

The Society has no special form for submitting nominating petitions. They may be written as follows:

We, the undersigned voting members of the Society of American Foresters, hereby nominate John Doe, a Member (or Fellow) for the office of president (or member of the Council) for the two-year term 1962-1963.

The form of acceptance of a nomination may read as folows:

I accept the nomination to the office of President (or to membership on the Council) of the Society of American Foresters for the two-year term 1962-1963, and agree to serve if elected.

No nomination will be considered valid unless supported by the nominee's acceptance in writing which should be attached to the nominating petition.

All nominating petitions should be sent promptly to the Society office, 425 Mills Building, 17th Street at Pennsylvania Avenue, N. W., Washington 6, D. C. The executive secretary will gladly provide information about nominating or election procedure.

According to the Constitution (Article VIII, Section 1) a Nominating Committee has been appointed by President Connaughton.

This committee is charged with the following duties:

1. To set the date of the election.

(December 2, 1961, is the date.)

2. To provide for at least two candidates for the office of president, and at least nine candidates for membership on the Council.

3. To receive separate nominating petitions for the office of president and for each member of the Council, and to supplement such petitions when necessary with other nominations in order to comply with item 2 above.

The Nominating Committee will make no nominations of its own unless the voting membership fails to make the required minimum number of nominations by petition. Voting members should accordingly get busy and make their own nominations. For their information the distribution of Council members by states during the period 1946-1961 is shown in Table 1, page 143, February issue.

Nominations Received

On the date of going to press the following nominations had been received:

For President

Paul M. Dunn, New York, N. Y. (Council Member 1946-1947, 1948-1949.)

J. Herbert Stone, Portland, Ore. (Council Member 1954-1955, 1956-1957, 1958-1959.)

For the Council

W. D. Hagenstein, Portland, Ore. (Council Member 1958-1959, 1960-1961.)

William A. Parr, Bel Air, Md.

Archie E. Patterson, Athens, Ga.

SETH G. HOBART, *Chairman*
Nominating Committee

Second Call for Fellow Nominations

All members (formerly Senior Members) and Fellows of the Society are hereby advised that nominations for the grade of Fellow are now open. The election of Fellows will be held at the time of the Society's regular biennial election, December 2, 1961.

As defined by the Constitution (Article III, Section 7), "Fellows shall be foresters recognized generally throughout the profession as persons who have rendered outstanding service to forestry and to the Society. They shall be elected from the Members."

Nominations by Petition

The procedure for placing Members in nomination for the grade of Fellow is by petition. The Society has no printed form for this purpose; the petition may be typewritten thus:

We, the undersigned Members and Fellows of the Society of American Foresters hereby nominate John Doe for election to the grade of Fellow in 1961.

Remember these simple rules:

1. A petition may not name more than one nominee.

2. It must be signed by not less than 25 Members or Fellows in good standing.

3. It must be accompanied by a factual, not eulogistic, biographical sketch of at least 300 words giving an account of the nominee's professional career and accomplishments.

4. It must be received in the executive office of the Society, 425 Mills Building, 17th Street at Pennsylvania Avenue, N.W., Washington 6, D. C., not later than September 16, 1961.

The executive employees of the Society cannot be responsible for obtaining signatures on partially completed petitions or on petitions incomplete by reason of unacceptable signatures (that is, signatures of other than Members and Fellows in good standing). Only those nominees' names will appear on the ballot whose petitions are complete and valid in all details as of September 16, the closing date.

Election Procedure

Fellows are not elected by the membership at large, but by a board of electors which consists of all present Fellows, the Council, the chairmen of the 22 Sections, and the chairmen of the 10 subject Divisions.

The system is described in Article IV, Section 4 of the Constitution. To win election a nominee must receive an affirmative vote of not less than one-half the total number of votes cast, as provided in Bylaw 11.

For the 1961 election there will be 135 electors, of whom 94 are Fellows. An elector has one vote only. Thus, a Fellow who is also a Council member has but one vote.

Significance of the Grade

The highest membership distinction that can be conferred by the Society, this grade is awarded in recognition of outstanding service to forestry and to the Society. Fellows do not pay increased dues; their dues are the same as those of Members.

Since the Society was founded in 1900, there have been 125 Fellows elected. At the present time the number of living Fellows is 94.

The current roster of Fellows, showing the state in which each is domiciled and the year of his election, was published in the February issue, page 145.

Nominations Received

On the date of going to press the following nominations for Fellow had been received:

Frank A. Albert, Jacksonville, Fla.

Robert S. Campbell, New Orleans, La.

Council's Column

The Fifth Year

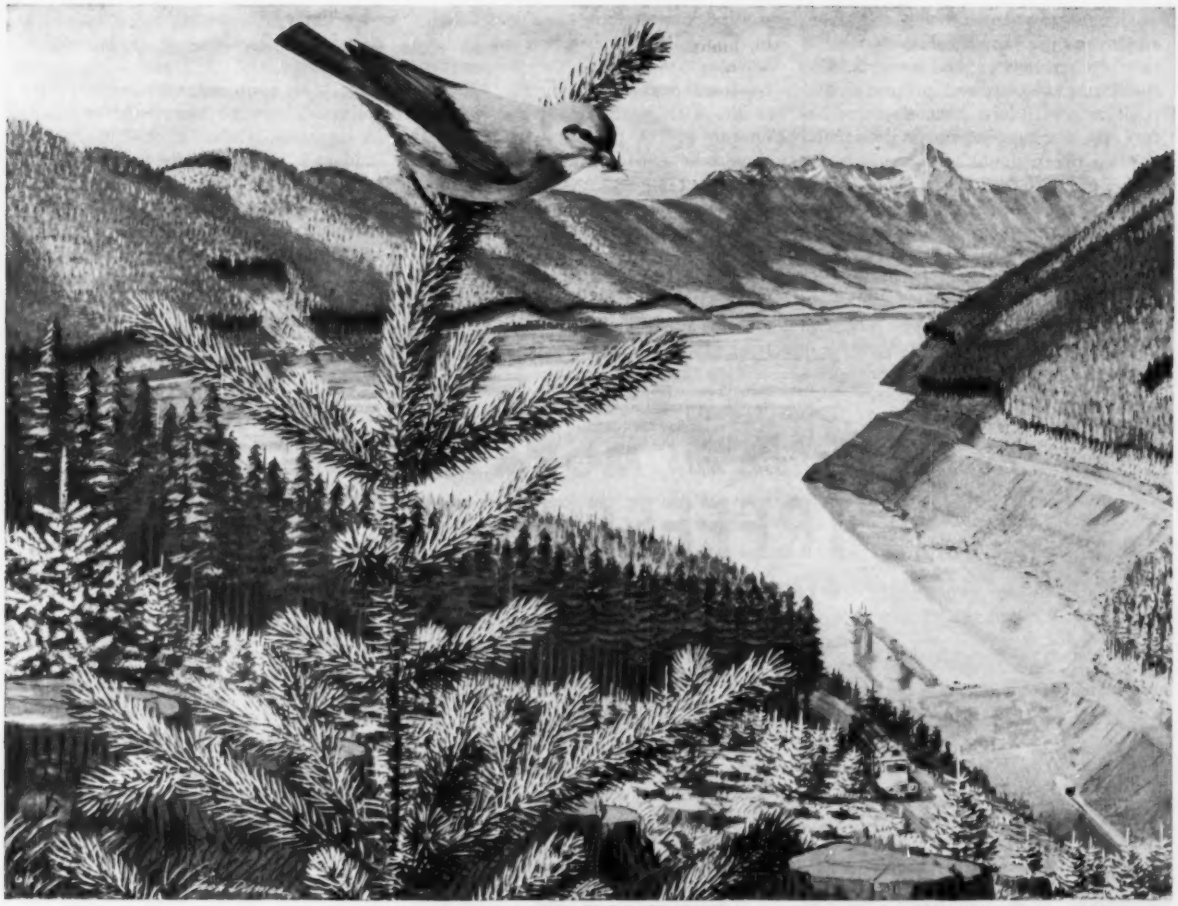
At the annual meeting in Washington, Dean Samuel T. Dana made the proposal that a fifth year be added to the undergraduate education of foresters. If this proposal is adopted by the Society and the forestry schools, it would be of profound importance for the stature of the profession.

Our professional stature rests upon the quality and quantity of education required of foresters. Much knowledge and experience is, of course, acquired after the early formal schooling. But the early schooling furnishes the foundation to build upon and, in particular, basic information and principles that are very difficult to obtain in practice.

A fifth year has been considered by the profession—and probably by every forestry school—many times. At every major curriculum revision in which this writer has participated, the fifth year has been reached for as the final straw that would solve the many ills. One of the reasons why the fifth year has not been adopted up to now may be that a firm agreement by all the schools is necessary, or perhaps because the Society has not made it a requirement for professional accreditation.

It looks now that the latter may be the case. Perhaps we can thank the Canadian forestry schools for this. All four Canadian forestry schools require in reality five years for the undergraduate degree. Students with "junior matriculation" must take five years for the bachelor degree, while students with "senior matriculation" (corresponding to the freshman year in U. S.) can do it in four years.

What the Canadian schools require, and with them most other forestry schools abroad, is a better foundation in the basic sciences and more so-called general education. This is why we also need a fifth year. Our students are not as well prepared in the basic sciences and in general education as they should be when they enter college. They have to spend a considerable amount of time in college on English.



SEATTLE'S TOLT RIVER RESERVOIR is to be completed in 1962. Under agreement with the city, Weyerhaeuser land in the watershed will continue to be managed for perpetual yield of timber crops.

Tolt River Dam . . . a story of good timberland management

Quality homes of wood are still America's best building buy. Many of the finest are built with beautiful west coast lumber sold under Weyerhaeuser's 4-Square trademark.

Water for the nation's expanding population and industry is a matter of grave concern in many regions. As new sources of water supply are developed, large areas of land are sometimes sealed off and their use restricted to watershed purposes. This is both unnecessary and unwise where commercial timberland is involved. Properly managed forestlands can supply *both* wood and water as twin crops, year after year.

The City of Seattle's Tolt River watershed is a case in point. It is comprised of federal, state and Weyerhaeuser timberlands, all of which are managed for sustained yield of timber crops. This practice is recognized by city officials as being fully compatible with use of the land as a watershed. As a result, the area will continue to produce wood for essential products, as well as water for the City of Seattle.

City officials and forestland owners in many other areas also can work out sensible long-range plans to meet future water and timber requirements. The accelerating demand for wood, water and other forest resources makes such cooperation vitally necessary.

Weyerhaeuser Company

Tacoma 1, Washington

The most common complaint from employers of young foresters is that they do not write good reports. But spelling, grammar, and ordinary composition should have been mastered before the student began his basic and applied professional courses. It is far easier to teach and learn such an important and constantly used tool as the native language at a very early stage in the educational career. Later on, it becomes a matter of unlearning and relearning, and that can be an arduous task after many language habits have grown fixed.

Special training in technical-report writing is something else. That belongs in the college curriculum at a time when it fits in with the proper professional courses.

The fifth year should not be used on top of the present curriculum. It should be used primarily to provide a better foundation. A professional forester should not only know the how's, he must first of all know the why's. It is up to him to formulate new how's. If he does not know what makes it all "tick," he may roll along on old how's modified only by practical experience.

Forestry depends on clear thinking, objectivity, mathematics, physics, chemistry, biology, and economics. Knowledge and skills in these areas cannot be acquired very easily after college. Thorough knowledge and skill in these fields should exist when the student is being exposed to the applied courses. This material should be learned before, and not coincidental with, or after, the professional training. Part of the time that a fifth year will offer could be used for a deeper and better training in the basic sciences.

But, in 1961, there is also a great need for more general education. A very large portion of a forester's job consists of dealing with people, contributing to the society he lives in and interrelating forestry with the social and economic factors that furnish the necessary environment for forestry. In other words, he should be a well-educated human being and not just a one-track technician.

A university community is filled with many extracurricular opportunities to develop one's general education—public lectures on current events or cultural subjects, concerts, debates, plays, etc. And the basic and technical courses can be offered in such a manner that students will be encouraged to take advantage of these opportunities. The important thing is the cultural atmosphere that is created within the forestry school. The kinds of newspapers and literature alone that the student needs mean a great deal for his personal development and future life habits and, eventually, for the kind of forestry he will practice. But, in addition, a few organized formal courses in the social sciences and humanities could well be included in the curriculum if we were to adopt the fifth year.

Finally, perhaps part of the additional time that a fifth year will make possible may be used to strengthen the technical courses. Here I shall only make a few observations. The technical forestry courses should deal with principles, rather than applications. And these principles should be understood well so that they may become useful tools for life. We should not fill our courses with un- or less essential facts, methods or techniques that distract from the heart of the matter. We should avoid putting emphasis on applications but should also certainly utilize, to a greater degree than is often done today, the forest and its products to demonstrate principles in structure, composition and influence of environment and treatment upon production and quality. In particular, students majoring in management need to become thoroughly "at home" in

Foresters get results with MORA
TREEFEED!
4-Year Test Results in Now!
TREEFEED — treated seedling
3.97 cm diam.
4th year growth
An increase
30%
greater than control seedlings
Control seedling
3.05 cm diam.
4th year growth
TREEFEED OFFERS FORESTERS
better establishment
•
greater profits
•
greater health, vigor
•
faster rotation
Mora TREEFEED fertilizer pellets have compact shape, concentrated formula. They are non-burning, slow-acting and long lasting, non-toxic, non-corrosive, have no odor, are economical and adaptable to all planting methods.
TREEFEED pellets have been thoroughly and reliably tested for most species of fir, pine, spruce and poplar.
—Now available: special experimental TREEFEED formulations for use in Lake States and South.
PROFITS GROW WITH TREEFEED
MAIL THIS COUPON TODAY!
MORA CHEMICAL CORP.
2450 6th Ave. S., Seattle 4, Wash.
JF
MORA CHEMICAL CORP.
2450 Sixth Ave. So., Seattle 4, Wash.
( ) Rush complete TREEFEED test data today.
Name
Address
City State

the woods and confident in their dealings with the many factors that influence the forest for better or worse. We need, therefore, more field work under experienced and well-planned guidance. Not primarily, I would emphasize, to teach technical applications but to teach principles.

Yes, indeed, we need the fifth year for our professional welfare and stature.

SVEND O. HEIBERG

Southeastern Section Holds Annual Meeting in Florida

With an attendance of 350 members, their ladies, and guests, the Southeastern Section held its annual meeting in Jacksonville, Fla., January 12 and 13, in the Robert Meyer Hotel.

The technical program was centered in the theme, "What Are the Responsibilities of the Profession in the Southern Forestry of the Future?"

Frank A. Albert of St. Regis Paper Company moderated the session on opportunities ahead in southern forestry.

James G. Yoho of the Duke University School of Forestry discussed "The Southeastern Industrial Forest Economy."

The topic "Population Impact on Forest Uses" was treated from two aspects: on recreation by K. B. Pomeroy of The American Forestry Association; and on water by James G. McClellan of American Forest Products Industries, Inc.

C. H. Coulter, state forester of Florida, was moderator of the panel on "The Forester's Responsibilities." G. W. E. Nicholson of Tennessee River Pulp and Paper Company told what the forest industry expects of its foresters. J. K. Vessey of the U. S. Forest Service explained what the public agency expects of its foresters.

A panel discussion on "Professional Training Required by Foresters to Meet Their Responsibilities" was moderated by C. M. Kaufman of the University of Florida School of Forestry.

The panelists were W. D. Smith of Buckeye Cellulose Corporation, R. R. Edgar of Bowaters Southern Paper Corporation, J. F. Pechanec of the Southeastern Forest Experiment Station, and R. J. Preston of North Carolina State College School of Forestry.

For the Section's annual dinner R. Vance Miles served as toastmaster. The address was given by Wayne Reitz, president of the University of Florida. Musical entertainment of excellent quality was presented.

Section Chairman Donald D. Stevenson presided at the business session. Following committee reports and other business the following officers were installed:

Chairman, James W. Owens, Jr., Tuscaloosa, Ala.

Vice chairman, H. Edward Ruark, Macon, Ga.

Secretary-Treasurer, Richard H. Riggs, Birmingham, Ala.

Present, representing the SAF Council, were President C. A. Connaughton, Vice President H. J. Malsberger, Councilman B. E. Allen, and Henry Clepper, executive secretary.

Division of Forest Fire Established by SAF Council

A petition, signed by 134 members, was submitted to the Council in November 1959. It requested the establishment of a subject Division of Forest Fire, in accordance with Article XII of the Constitution.

The Council authorized a committee to explore the need for such a Division

The McGraw-Hill American Forestry Series

Allen & Sharpe—AN INTRODUCTION TO AMERICAN FORESTRY
466 pages, $7.95

Baker—PRINCIPLES OF SILVICULTURE
414 pages, $8.00

Boyce—FOREST PATHOLOGY
Third Edition in Press

Brockman—RECREATIONAL USE OF WILD LANDS 346 pages, $8.50

Brown, Panshin, & Forsaith — TEXTBOOK OF WOOD TECHNOLOGY
Vol. I, 626 pages, $10.00; Vol. II, 761 pages, $13.00

Bruce & Schumacher—FOREST MENSURATION 467 pages, $8.50

Chapman & Meyer—FOREST MENSURATION 522 pages, $8.50

Chapman & Meyer—FOREST VALUATION
490 pages, $8.50

Clawson—THE WESTERN RANGE LIVESTOCK INDUSTRY 401 pages, $7.50

Dana—FOREST AND RANGE POLICY
455 pages, $7.95

Davis—AMERICAN FOREST MANAGEMENT
482 pages, $7.75

Davis—FOREST FIRE 584 pages, $12.50

Duerr—FUNDAMENTALS OF FORESTRY ECONOMICS 579 pages, $9.50

Graham—FOREST ENTOMOLOGY
351 pages, $7.50

Greeley—FOREST POLICY 267 pages, $6.50

Guise—THE MANAGEMENT OF FARM WOODLANDS 356 pages, $7.00

Harlow & Harrar—TEXTBOOK OF DENDROLOGY 561 pages, $9.50

Hunt & Garratt—WOOD PRESERVATION
405 pages, $9.00

Panshin, Harrar, Baker, & Proctor—FOREST PRODUCTS—THEIR SOURCES, PRODUCTION, AND UTILIZATION 549 pages, $9.00

Preston—FARM WOOD CROPS
302 pages, $6.50

Shirley — FORESTRY AND ITS CAREER OPPORTUNITIES 467 pages, $7.50

Stoddart & Smith—RANGE MANAGEMENT
433 pages, $8.50

Trippensee—WILDLIFE MANAGEMENT
Vol. I, 479 pages, $6.95; Vol. II, 572 pages, $8.00

Wackerman—HARVESTING TIMBER CROPS 437 pages, $8.00

Send for copies on approval

McGraw-Hill Book Company, Inc.
330 West 42nd St. New York 36, N. Y.

Saving minutes with portable radio means saving lives and timber! When your forces are stretched thin . . . when every minute counts—instant 2-way radio contact can multiply the effectiveness of every man and machine on the fire line.

And in coordinating everyday operations, the Motorola "Handie-Talkie" radio proves so versatile and reliable that 8 out of every 10 portable 2-way radios are Motorola! And for good reasons—they are the lightest, toughest and most economical-to-operate units made. Motorola offers 74 models with standard or "Private-Line" operation, dry cell or rechargeable nickel-cadmium battery supply, speaker-microphone or telephone-type handset options—and up to 8 watts RF output.

Important, too, is the fact that each model is designed and produced by Motorola 2-way radio experts—backed by almost 3 decades of communications experience. Units are job-matched to your needs by a factory-employed Motorola Sales Engineer. And you can depend on nearby Motorola factory-supervised service to keep your equipment on-the-job. Write for full facts today.

MOTOROLA
Handie-Talkie®
RADIOPHONE

Handie-Talkie, Private-Line are registered trademarks of Motorola Inc.
Motorola Communications & Electronics, Inc., 4501 Augusta Blvd., Chicago 51, Ill. A Subsidiary of Motorola Inc.

and to indicate the scope of its activities. Council member Kenneth P. Davis acted as chairman of the committee, serving with Jack S. Barrows, Edward M. Gaines, and Kenneth J. Seigworth.

At the Council meeting held in Washington, D. C., November 13 and 16, 1960, the Council voted to authorize formation of the Division (JOURNAL OF FORESTRY, January 1961, page 34). In order that the new Division might have officers to arrange a program for the 1961 annual meeting and to appoint committees, President Connaughton designated the following members to serve until an election can be held next October:

Chairman, Jack S. Barrows, Northern Forest Fire Laboratory, U. S. Forest Service, Missoula, Mont.

Vice Chairman, C. Huxley Coulter, Florida Forest Service, Tallahassee, Fla.

Secretary, Sture T. Carlson, National Park Service, U. S. Department of the Interior, Washington 25, D. C.

The Society now has ten subject Divisions as follows:

Division of Economics and Policy.
Division of Education.
Division of Forest Fire.
Division of Forest Management.
Division of Forest Products.
Division of Forest Recreation.
Division of Forest-Wildlife Management.
Division of Range Management.
Division of Silviculture.
Division of Watershed Management.

Article XII of the Constitution provides for the establishment of subject Divisions, as follows:

"Subject Divisions of the Society may be authorized by the Council upon the written petition of twenty or more voting members of the Society engaged in the special field of forestry to which the Division pertains, at least five of whom shall be Members or Fellows of the Society. Subject Divisions shall be organized only as the Council is convinced of their need, and they shall be regulated through bylaws established by the Council."

Necrology, 1960

Fellow

Besley, F. W., Laurel, Md.
Butler, Ovid M., Washington, D. C.
Curran, Hugh M., Frankfort, Ind.
Hall, Wm. L., Hot Springs, Ark.
Hartman, George B., Ames, Iowa
MacDonald, G. B., Ames, Iowa
Winslow, Carlile P., Washington, D. C.

Honorary

Pavari, Dr. Aldo, Florence, Italy.
Stebbing E. P., Smarden, England
Whittemore, Laurence F., Concord, N. H.

Member

Barr, P. M., Berkeley, Calif.
Breon, T. F., Conway, N. H.
Carlisle, George T., Bangor, Maine
Conard, W. Kay, Everglades, Fla.
Dewald, Floyd I., Trenton, N. J.
Drissen, J. Philip, New Town, N. D.
Goulden, James J., Norris, Tenn.
Heers, Erwin A., St. George, Va.
Henry, John R., Atlanta, Ga.
Jacobson, Norman G., Tacoma, Wash.
Jensen, Arthur W., Alexandria, Va.
Jolley, L. G., Portland, Ore.
Kennedy, J. D., Cortland, N. Y.
Kline, Charles W., Medford, Ore.
Krinbill, Howard R., Webster, N. Y.
Melcher, Edmund C., Cumberland Mills, Maine
Pooler, F. C. W., Albuquerque, N. Mex.
Proell, A. K., Keene, N. H.
Spaulding, Perley, New Haven, Conn.
Tryon, Henry H., Cornwall-on-Hudson, N. Y.
Turner, Lewis M., Logan, Utah
Wade, Irving W., Billerica, Mass.
Young, Leigh J., Ann Arbor, Mich.

Junior

Gardner, Paul E. Jr., Milledgeville, Ga.
Locke, John P., Colebrook, N. H.
Schoberg, Franklin P., Isabella, Minn.

Associate

Clark, Edwin C., Moscow, Idaho
Cowles, Frederick H., Santa Barbara, Calif.
Edgerton, D. Priscilla, Mrs., Washington, D. C.
Kurth, Ernest L., Keltys, Texas
Moore, Agnes E., Mrs. Dixon, Ill.

Corresponding

Aquino, Roman R., Manila, P. I.

Leigh J. Young (1883-1960)

Leigh J. Young, 77, former professor of silviculture in the University of Michigan School of Natural Resources, died in Ann Arbor, Mich., on December 24, 1960.

Born March 31, 1883, in Albia, Iowa, he attended Columbia University for two years, then studied forestry at the University of Michigan, receiving the M.S.F. degree in 1911.

Following temporary and seasonal forestry employment in the U. S. Forest Service, in teaching, and in industry, he became an assistant professor of silviculture at the University of

PACIFIC WEATHER SERVICE
WEATHER: Forecasts—Warnings—Modification.
Fire Danger Rating—Instruments
J. B. "Ben" Melin, Meteorologist
1222 N.E. 117th Ave., Portland 20, Oregon
AL. 2-5410

FOR SALE
Slash, Loblolly, Longleaf
and
Shortleaf Pine Seed
In Wholesale Quantities
Treated with Rodent and Bird Repellent For Direct Seeding
For over ten years
a dependable source
for
Southern
Pine
Seed
SOUTHERN SEED COMPANY, INC.
Baldwin, Georgia

LITTLE BEAVER
ONE MAN—KILLS 10 ACRES PER DAY
The Little Beaver Tree Girdler is the most economical means of killing trees of all types, sizes and shapes. In use for the past five years by the majority of the large timber growers and the U.S. Forest Service. Use this proven machine in your T.S.I. operations as thousands of others have.
KILL CULL TREES
THE LITTLE BEAVER WAY
HAYNES
Pine Tree Pruner
• Four edge cutting tool
• Only a light stroke required to clip limbs up to 1½ inches.
• Different length handles for all pruning stages.
PRECISION BUILT
SIMPLE TO OPERATE
See your dealer or write.
HAYNES MANUFACTURING CO.
LIVINGSTON, TEX.

Michigan in 1914, and was a member of the forestry faculty until his retirement in 1953.

Prof. Young served as acting chairman of the University's Department of Forestry during the period 1923-1927, and in the latter year served as director of conservation for the State of Michigan. Beginning in 1922 he was in charge of field work for the Michigan Land Economic Survey until it became a part of the State Department of Conservation.

In the early advancement of the University of Michigan forestry program, he helped acquire and develop the nursery and forest properties for instruction and research.

He became a Member of the Society of American Foresters in 1916, and in 1925 was chairman of the Central States Section. He was a past president of the Michigan Academy of Science, Arts, and Letters.

Active in civic affairs, he was an alderman of the City of Ann Arbor for eight years, president of the city council for five years, and mayor during the period 1941-1945.

EVERGREEN SEEDLINGS
and transplants in leading varieties for Christmas tree production.
Assorted ornamentals.
Free price list and planting guide
Fliekinger's Nursery
Sagamore 16, Pa.

REMOVE LIGHT GLOBES 60 ft.
Wash Windows Three Stories High
PRUNE TREES & PICK FRUIT
60 ft. up

PHONE OR WRITE FOR
Free 24-Page Catalog
MFRS. OF A COMPLETE LINE OF
SWIMMING POOL EQUIPMENT
SOLD DIRECT TO YOU
POOL BRUSHES • RAKES
SKIMMERS • PUMPS
LIFE BUOYS
PLASTIC HOSE
DIVING BOARDS
POOL HEATERS
POOL FILTERS
POOL SLIDES
POOL BOATS
POOL CHEMICALS
POOL COVERS
FILTERS
PUMPS
COVERS
HEATERS
MAdsn 6-9397
J. B. Sebrell
DEPT. 301 S. SAN PEDRO ST.
LOS ANGELES 13, CALIFORNIA

Coming Events

To Hold Joint Meeting

The Inland Empire Section of the Forest Products Research Society and the Northwest Wood Products Clinic will hold their annual combined meeting at the Davenport Hotel, Spokane, Wash., April 11-12, 1961.

National Watershed Congress

The 8th National Watershed Congress will be held at the Ramada Inn, Tucson, Ariz., April 17-19, 1961.

Puget Sound Section

The Puget Sound Section will hold its Annual Section Meeting on April 28-29, 1961, at the Morek Hotel, Aberdeen, Wash.

Columbia River Section

The Columbia River Section will hold its annual meeting May 5-6, 1961, at the Marion Hotel, Salem, Ore.

Gulf States Section

The Gulf States Section will hold its annual meeting at the Edgewater Gulf Hotel, Biloxi, Miss., May 8-9, 1961.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of January are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of March 31, 1961.

Communications from the voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Frayer, W. E.

WEST VIRGINIA UNIVERSITY

Bucklew, R. F.
Glover, R. P.
Griffin, M. T.
Hauck, W. R.
Lambert, L. T.
Masenheimer, P. G.
McPherson, L. C.
Mollish, A. P.
Riley, J. W.
Sanderman, D. L.
Walls, D. T.
Wood, G. P.

Junior Grade

Cooper, C. E., Service Forester, Pa. Dept. of Forests & Waters, Clarion, Pa. Pa. State, BSF, 1956.

Member Grade

Craft, R. E., Mgmt. Forester, W. Va. Pulp & Paper Co., Coudersport, Pa. (Junior 1954).
Lindstrom, T. C., Mgr., Towanda Tree Farm, Towanda, Pa. (Junior 1954).
Wawrynovic, F. J., Consultant & Forestry Equipment Dealer, Self-Employed, Clearfield, Pa. (Junior 1954).

Affiliate Grade

Hevener, R. D., Forester, USFS, Elkins, W. Va.

Appalachian Section

Junior Grade

King, G. W., Nursery Supt., Va. Div. of Forestry, Providence Forge, Va. (Reinstatement).
Sheehan, P. J., Forester, USFS, Covington, Va. State Univ. N. Y., BSF, 1957.
Stebbins, C. H., Forester, U. S. Plywood Corp., South Boston, Va. (Reinstatement).

Students Eligible for Automatic Advancement

NORTH CAROLINA STATE COLLEGE

Ball, W. R.
Blizzard, D. D.
Jeffries, K. F.
Miller, R. W.
Nichols, L. A.
Smith, J. H.
Sykes, P. W.
Tyson, R. L.
Waters, J. E.

Member Grade

Montgomery, C. A., 104 Park Heights Union, S. C. (Junior 1954).

Affiliate Grade

Tokarz, E. F., Asst. Supt., The Chesa-

CHRISTMAS TREE SEEDLINGS—
of the best quality—grow trees for Profit, Conservation, Beauty and Recreation. Scotch pine from our own blue-green handpicked seed, selected for best Christmas tree qualities. Write for Catalog of wide selection of seedlings, transplants, and ornamental evergreens.
PAINT CREEK NURSERIES
Shippenville, Pa.

ROOTSPRED TREE PLANTERS
- **Proven non-clogging design in a 3-point hitch scalping planter**
- **Scarifying point which travels several inches deeper, breaking the soil for better root penetration**
- **Simple, strong, low-maintenance design**
- **Professional consulting service on your specific planting problems**

Write for additional information to
ROOTSPRED CO.,
ST. PETERSBURG, PA.

peake Corp. of Va., West Point, Va.

Associate Grade

Lowry, S. T., Asst. Prof., Washington & Lee Univ., Lexington, Va.

Central Rocky Mountain Section

Student Grade

COLORADO STATE UNIVERSITY

Starkey, J. R.

Central States Section

Junior Grade

Students Eligible for Automatic Advancement

PURDUE UNIVERSITY

Allen, R. K. Blance, A. J.

Member Grade

Idleman, M. K., Staff Forester, Ohio Div. of Forestry, Columbus, Ohio (Reinstatement).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Olson, W. R. Woodard, E. S.

Junior Grade

Churchill, G. W., Forester, USFS, Portland, Ore. (Reinstatement).

Coates, H. W., McKenzie Bridge, Ore. (Reinstatement).

Duncan, L. E., Project Eng., U. S. Bur. of Land Mgmt., Roseburg, Ore. Ore. State, BSF, 1954.

Egger, B. E., Dist. Ranger, USFS, Bly, Ore. Univ. Idaho, BSF, 1951.

Malone, J. E., Forester, USFS, Kelso, Wash. (Reinstatement).

Thornton, G. A., Hebo, Ore. (Reinstatement).

Students Eligible for Automatic Advancement

OREGON STATE COLLEGE

Burwell, B. B. Gannon, J. F.
Inglis, L. H.

Affiliate Grade

Kucera, D. A., Forester, U. S. Bur. of Land Mgmt., Eugene, Ore.

Gulf States Section

Junior Grade

Students Eligible for Automatic Advancement

LOUISIANA POLYTECHNIC INSTITUTE

Gibson, H. J. Reschar, J. C.

LOUISIANA STATE UNIVERSITY

Anderson, M. H. Cooley, J.
Cole, R. Jung, M. W.
Monk, D. L.

Member Grade

Bilan, M. V., Stephen F. Austin State College, Dept. of Forestry, Nacogdoches, Texas (Junior 1954).

Boatman, J. H., Forester, Newport Industries Co., DeQuincy, La. (Affiliate 1951, Junior 1953).

Crocker, G. R., Forester, International Paper Co., Zwolle, La. (Junior 1954).

Cromer, G. J., Forester, Crown Zellerbach Corp., Bogalusa, La. (53R55).

Delaney, C. F., La. Forestry Comm., Baton Rouge, La. (Junior 1954).

Engelking, T. G., Gen. Mgr., East Texas Wood Treating Co., Inc., Nacogdoches, Texas (40R57).

Giaquinto, E. J., Dist. Ranger, USFS, Crockett, Texas (51R55).

Hatchell, G. E. Research Forester, Southern Forest Expt. Station, Pineville, La. (52R56).

Moore, J. E., Forester, Frank W. Bennett & Assoc., Alexandria, La. La. State, MF, 1957 (Junior 1958).

Nutter, O. H., Forester, International Paper Co., Brookhaven, Miss. (Junior 1954).

Parks, J. G., Unit Forester, International Paper Co., Woodville, Texas (Junior 1954).

Remel, J., Forester, International Paper Co., Pearlington, Miss. (Junior 1954).

Steen, C. N., Forester, International Paper Co., Winona, Miss. (Junior 1954).

Affiliate Grade

Bell, W. T., Forester, Forestry Consultants, Inc., Jackson, Miss.

Hurdle, M. T., Mgmt. Forester, Miss. Forestry Comm., Ashland, Miss.

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Garthe, G. M. Murphy, B. C.
Nielsen, E. P.

Junior Grade

Student Eligible for Automatic Advancement

UNIVERSITY OF IDAHO

Rea, R. B.

Intermountain Section

Student Grade

UTAH STATE UNIVERSITY

Anhold, M. L. Freeman, D. W.

New England Section

Student Grade

UNIVERSITY OF MAINE

Authier, P. H.

UNIVERSITY OF NEW HAMPSHIRE

Frazer, P. O.

YALE UNIVERSITY

Franklin, R. D.

Junior Grade

Student Eligible for Automatic Advancement

UNIVERSITY OF MASSACHUSETTS

Byers, D. B.

Member Grade

McCamey, F., 41 Orchard Acres, Storrs, Conn. (Reinstatement).

Van Husen, C. M., Dist. Forester, Scott Paper Co., Jackman Station, Maine. State Univ. N. Y., BSF, 1955 (Junior 1955).

Affiliate Grade

Swan, H. S. D., Research Forester, Pulp & Paper Research Institute of Canada, Montreal, P. Q., Canada.

New York Section

Student Grade

STATE UNIVERSITY OF NEW YORK

Pringle, P. C.

Member Grade

Darrow, C. E., Regional Mgr., Nat'l. Lumber Mfg's. Assoc., Cross River, N. Y. (Junior 1954).

Northern California Section

Student Grade

UNIVERSITY OF CALIFORNIA

Chester, G. S. Larson, D. L.
Duckworth, W. A. Romm, J. M.

Junior Grade

Fridley, V. A., Sub-Foreman, Pacific Gas & Electric Co., Watsonville, Calif. Ore. State, BSF, 1936.

Ben Meadows

recommends

THE POTTS MIST BLOWER

New 1961 Models

The Potts Mist Blower is Ben Meadows' answer to modern forestry's pressing need for a rugged, economical tool for the application of concentrated sprays in brush and hardwood control. An enviable record of performance has already been achieved with the Potts Mist Blower by federal and state agencies, industry and other timber growers—and the 1961 models, including a new economy model, have been greatly improved to make them even more serviceable. For example, a larger fan and outlets enable the 1961 models to deliver a third more air, thus achieving greater coverage.

Write today for full details

With the Potts Mist Blower you can apply herbicides, insecticides and other pesticides in finely atomized, highly concentrated form—effectively and economically

Model No. S, with Tank.....$795.00

Model No. E, without Tank.....$680.00

The Ben Meadows Company

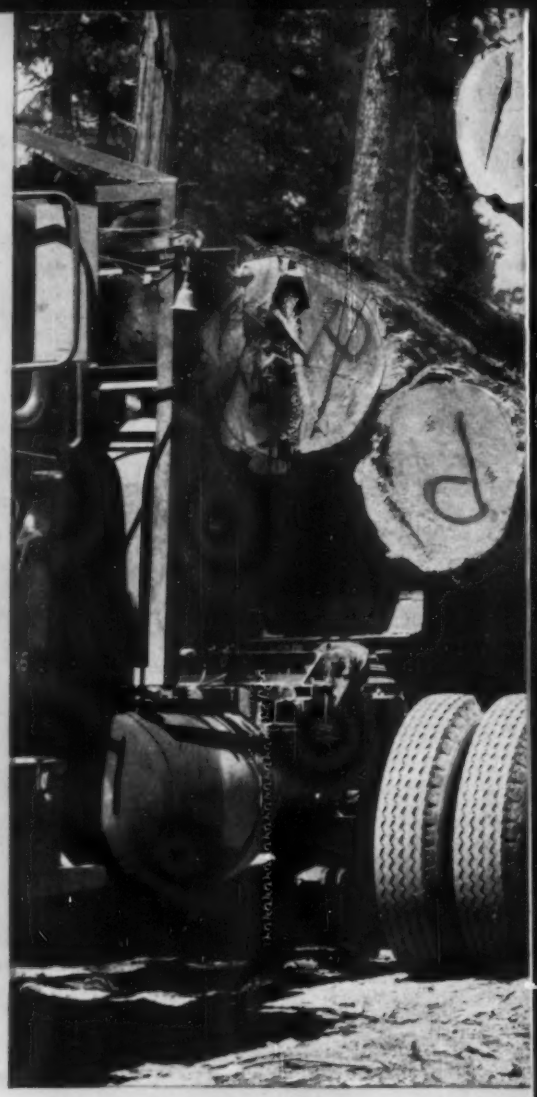
315 Pharr Rd., N.E. Atlanta 5, Georgia

"We load... build roads... skid logs ... save money

with

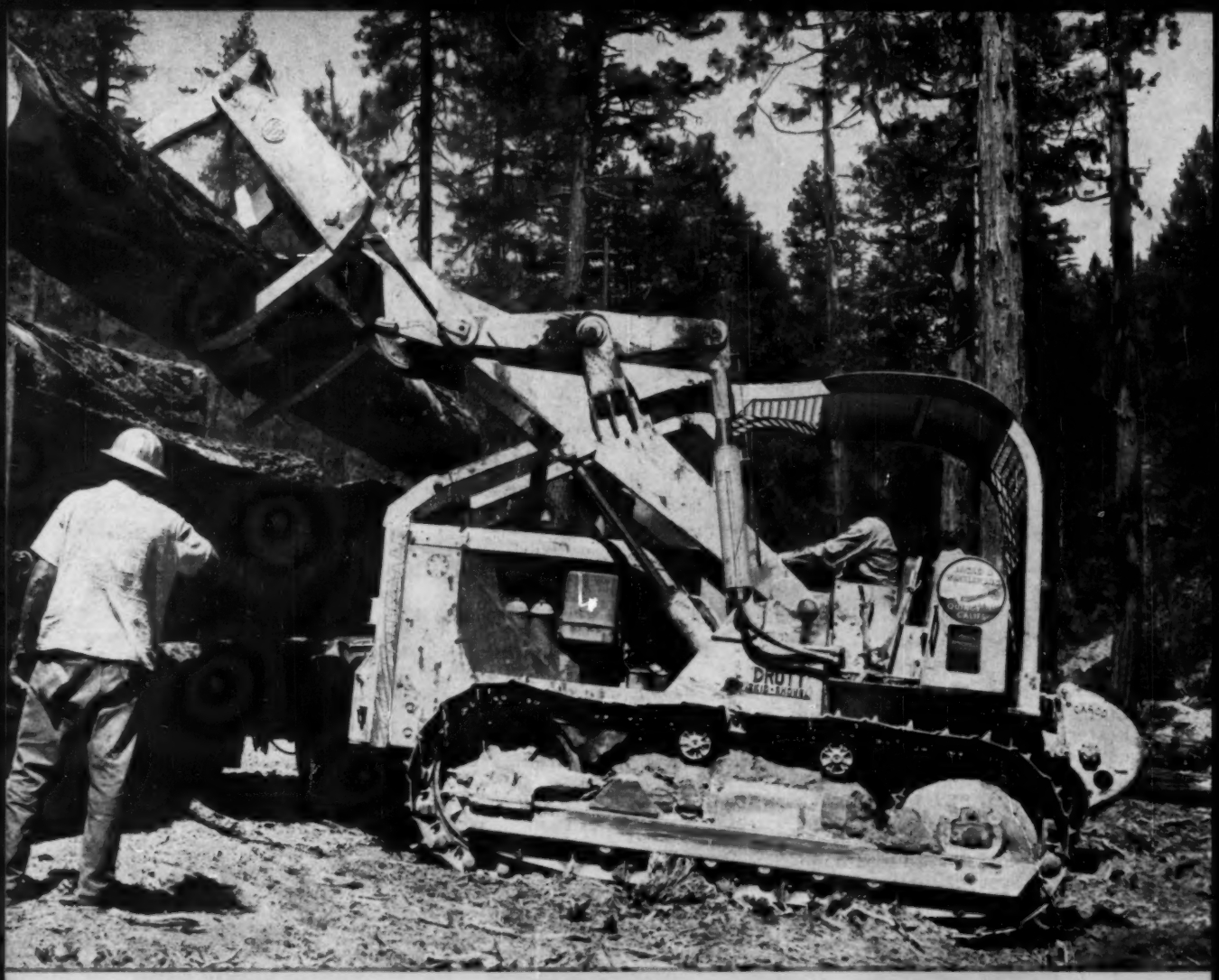
International DROTT Skid-Grapples"

—Jack & Winkler, Inc.,
Quincy, California



Here's Jack & Winkler's TD-15 Skid-Grapple, skidding from steep mountain slopes—between its log-loading chores. In winter, both units keep busy, building and surfacing roads—to keep the show going efficiently next season.

Norman Winkler, of Jack & Winkler, Inc., Quincy, California credits versatile International Drott Skid-Grapple performance for being a key factor in his success as a mountain logger. His firm brings out 70,000 bf daily in rough country.



Jack & Winkler's TD-20 Skid-Grapple eases a good-sized stick on the truck. Top grab-arm, with control-power provided by third-valve, holds log load securely while transporting—allows accurate spotting and gentle release to put on well-balanced loads, and protect truck components.

"Our International Drott TD-20 Skid-Grapple loaded the entire 8 million bf we logged the first year —and we did a lot of the skidding besides," states Norman Winkler, of Jack & Winkler, Inc., Quincy, California.

"Our first winter this outfit built over two miles of truck haul roads and a lot of skid trails with Bull-angledozer blade attachment. We also got the 4-in-1 bucket to load rock on trucks to surface new road.

"The Skid-Grapple is no 'one-shot' machine. I figure this outfit cut our logging costs by one-third, or more, compared to usual methods of loggers my size.

ADDS TD-15 SKID-GRAPPLE

"That's why we expanded by adding a TD-15 Skid-Grapple. Our two units load logs and skid—and give the extra advantages of dozing, and loading rock, to build roads.

"I believe the International Drott Skid-Grapple is equipment loggers like us can't do without."

See how drastically you can cut log-loading costs —in line with today's financial facts of life—with the size of Skid-Grapple you need. Measure Skid-Grapple capacity and strength—note the exclusive performance protection of shock-swallowing Hydro-Spring. Observe that every International Drott Skid-Grapple size has a smooth, 6-cylinder Diesel engine—of ample hp to slug out the work. Let your International Drott Distributor demonstrate.

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL® DROTT®

For Better Tree Marking

Nelson

leads the way

WITH BETTER PAINT

Specially formulated to do the job better, easier and more economically. Non-settling and non-skinning. No stirring — no plugging of guns — saves time. Greater visibility and covering capacity — saves paint. Extremely durable — and — quality controlled to assure uniformity of every shipment.

WITH BETTER TOOLS

The Nelson "Aero-Spot" is the only aerosol can containing real tree marking paint — Nelson's specially developed paint for forestry work. For identifying trees or logs by banding, numbering or lettering. Ideal for C.F.I. work, boundary marking, seed tree marking, small scale or intermittent tree marking.

"NEL-SPOT" D-103 MARKING GUN for Nelson quarts. BACK-PACK AND SIDE-PACK for Nelson gallons. "NEL-SPOT" PAINT HAMMER for end marking.

You save with the combination of NELSON PAINT and the proper "Nel-Spot" marking tool. You will find that the best is the most economical.

Write

THE NELSON PAINT COMPANY

Box 349, Iron Mountain, Mich.
Box 1892, Montgomery, Ala.
Box 402, McMinnville, Ore.

THREE PLANTS TO SERVE YOU

Radford, A. L., Mendocino Co. Assessor's Office, Ukiah, Calif. (Reinstatement).

Students Eligible for Automatic Advancement

UNIVERSITY OF CALIFORNIA

Dunaway, D. J. — Paulsen, D. W.
Henchell, F. G. — Porter, J. E. C.

Member Grade

Gilligan, J. P., Ext. Forester, Univ. of Calif., Berkeley, Calif. (Junior 1954).
Haas, R. G., Forester, Bur. of Land Mgmt. Ukiah, Calif. (Junior 1953).
Kuhn, C. W., Forester, Bur. of Land Mgmt., North Highlands, Calif. (Junior 46R58).

Affiliate Grade

Kennedy, J. T., Tbr. Mgmt. Asst., USFS, Milford, Calif.
Reedy, C. A., Forester, USFS, Placerville, Calif.
Wolcott, H. E., Forester, Simpson Redwood Co., Klamath, Calif.

Northern Rocky Mountain Section

Junior Grade

Student Eligible for Automatic Advancement

MONTANA STATE UNIVERSITY

Moorhouse, J. A.

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI

Pribble, J. L. (Reinstatement)

Junior Grade

Snodgrass, B. K., Dist. Forester, Umpire Dist., Umpire, Ark. (Affiliate 1959).

Students Eligible for Automatic Advancement

UNIVERSITY OF MISSOURI

Backler, W. E. — Palone, W. L.
Kline, D. E. — Richmond, G. B.
McGuigan, D. D. — Spellman, D. L.
Wilkins, L. F.

Member Grade

Berry, F. H., Forest Pathologist, USFS, Columbia, Mo. (Reinstatement).

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Alban, D. H.

Junior Grade

Thomson, F. M., Tbr. Mgr., Peninsula Plywood Corp., Port Angeles, Wash. (Reinstatement).

Southeastern Section

Junior Grade

Flora, R. L., County Forester, Fla. Forest Service, Bartow, Fla. (Reinstatement).
Morris, F. J., Forest Mgr., Ga. Kraft Co., Lula, Ga. Univ. Ga., BSF, 1959.

Students Eligible for Automatic Advancement

AUBURN UNIVERSITY

Blackwell, W. C. — Oberhausen, J. J.
Huffman, J. — Shelton, D. L.
Nolen, M. D. — Westmoreland, D. L.

UNIVERSITY OF FLORIDA

Mills, I. D. — Paige, V. G.

UNIVERSITY OF GEORGIA

Allison, H. D. — Mears, C. P.
Becton, H. E. — Mixon, J. W.
Bolton, R. G. — Parten, T. R.
Bond, L. E. — Steinbeck, K.
Crosby, F. F. — Todd, J. J.
Harris, G. J. — Waters, R. O.
Hill, J. F. — Waters, T. A.
Hinson, J. W. — Wetherbee, F. P.
Hinson, W. B. — Wood, J. H.
Lamb, C. B. — Woodard, C. D.

Member Grade

McDaniel, T. J., 610 Mohawk St., Mobile, Ala. (Junior 1951).
Wobrock, P. G., 408 Arthur St., N. W., Huntsville, Ala. (Junor 1954).

Affiliate Grade

Goodner, W. G., Director, Southern Crate & Veneer Co., Macon, Ga. (Reinstatement).

Southwestern Section

Junior Grade

Mihok, E. A., Forester, Fort Apache Indian Agency, Whiteriver, Ariz. (Reinstatement).

Affiliate Grade

Williams, D. E., Dist. Forest Ranger, USFS, Willcox, Ariz.

Upper Mississippi Valley Section

Student Grade

UNIVERSITY OF MINNESOTA

Heisler, T. P. — Strand, R. H.
Hill, E. W. — Ziegler, M. B.

Junior Grade

Students Eligible for Automatic Advancement

IOWA STATE UNIVERSITY

Kent, H. D. — Manwiller, F. G.
Warrick, C. D.

UNIVERSITY OF MINNESOTA

Erickson, G. A. — Lang, T. D.
Farweda, C. E. — Lewis, D. K.
Hilliker, R. L. — Oberg, V. E.
Roam, G. A.

Washington Section

Junior Grade

Hair, D., Research Forester, USFS, Washington, D. C. (Reinstatement).

Wisconsin-Michigan Section

Student Grade

MICHIGAN COLLEGE OF MINING & TECHNOLOGY

Holli, D. V. — Paddock, R. W.
Robbins, E. S.

UNIVERSITY OF MICHIGAN

Codnman, S. W. — Reynolds, H. H.
Gusler, O. B. — Spoon, C. W.

Junior Grade

Clifford, E. D., Forester, Chittenden Nursery, Wellston, Mich. (Reinstatement).
Kageorge, M. W., Forester, USFS, Milwaukee, Wis. (Reinstatement).
Rausch, T. J., Area Supv., Wis. Cons. Dept., Madison, Wis. (Reinstatement).

Students Eligible for Automatic Advancement

MICHIGAN COLLEGE OF MINING & TECHNOLOGY

Kwiatkowski, J. A.

MICHIGAN STATE UNIVERSITY

Bennett, B. L. — Crockett, D. B.
Hanson, C. A.

UNIVERSITY OF MICHIGAN

Ferguson, D. E. — Moholt, P. A.
Loch, E. F. — Whitmore, J. L.

No Section

Corresponding Grade

Srboljub Dobrivojevic, Director, Soil Cons., Zvornik, Yugoslavia.
Stefanija Sanovic, Sec., Chamber of Forestry, Titograd, Yugoslavia.

Forestry News

Forest Service Chief McArdle Wins Top Career Award

Forest Service Chief Richard E. McArdle on January 11 received from the President the nation's top civilian career service award, for which he was publicly commended by Secretary of Agriculture Ezra Taft Benson.

Dr. McArdle and four other Government career executives were given the coveted President's Gold Medal Award for distinguished federal civilian service by President Eisenhower in a ceremony at the White House.

The citation for Dr. McArdle declared that his "imagination, vision and inspiring leadership have brought exceptional progress in the development and protection of vital forest resources for the American people now and for generations to follow."

USFS Chief receives President's Gold Medal Award.

After serving in all major forest regions of the country, Dr. McArdle has headed the Forest Service since 1952. His early career was in forestry research from which he rose to the directorship of two regional experiment stations. He also served for eight years as assistant chief in charge of cooperative federal-state-private forestry programs.

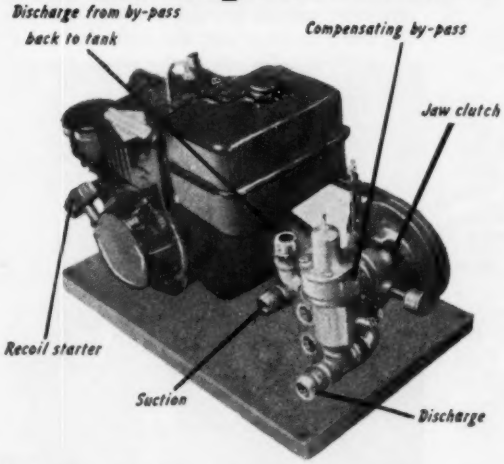
A native of Kentucky, he holds B.S., M.S., and Ph.D. degrees from the University of Michigan, which also awarded him an honorary Sc. D. degree. For a time he was dean of the School of Forestry at the University of Idaho. He is a veteran of overseas Army service in World War I.

Dr. McArdle has been elected three times to the Council of the Society of American Foresters, is now a Fellow.

PANAMA'S Newest Slip-On Unit - - - Model 200

It is designed to get even greater utilization from every gallon of the always limited supply of Water.

It is a utility pump in that it can be used for Fire Suppression, general spraying or for any service where a small volume of liquid is to be delivered under high pressure.



With more than one quarter century's experience in building small Fire-fighting pump Units for Tank Truck service in the Control and Suppression of Woods Fires we proudly present our Model 200.

This Unit is equipped with Herringbone Gear Ball Bearing pump for long efficient service—Independent Clutch enabling the operator to run the Engine without the pump being in operation—Compensating By-pass to maintain even pressure at all times and to allow operator to open and close the nozzle as water is needed—Overflow connection for returning excess water back to Tank without waste—Reduction V Belt Drive—Briggs and Stratton Engine.

Our many many years of experience in building Pumps and Forestry Tools and our policy of fair dealing assures you that you may buy PANAMA Products with confidence.

PANAMA PUMP COMPANY

HATTIESBURG P O BOX 689 MISSISSIPPI

SAFEST, SIMPLEST DRIP TORCH ON THE MARKET

FORESTER
Seal-Tite Torch
Approved for Use by U. S. Forest Service

Fuel trap, check valve and flash-back screen provide protection from explosion hazards.

Welded tank with cushion base, double bottom, oil proof gaskets and tight valves Seal-Tite against leakage.

No pressure—no pre-heating. No explosive fuel. Burns diesel oil, stove oil or mixed fuels with low flash-point.

WESTERN FIRE EQUIPMENT COMPANY
69 Main Street San Francisco 5, USA
Branch: Portland, Oregon

GROW Sturdy PINE

Rid pine forests of choking brush. Use R-H Injection Fluid or spray with L. V. Brush Rhap; contains 2,4,5-T formulated for economical pine release. For free information write

Reasor-Hill Corporation, Box 36JF, Jacksonville, Ark.

PROCEEDINGS
(1960)
Washington, D. C. Meeting

A special volume containing all Division and General Session papers presented at the Society's 60th Annual Meeting held in Washington, D. C., November 13-16, 1960.

Theme: "Forestry's Expanding Horizons"

Postpaid $5 per copy

Send order with check.

SOCIETY OF AMERICAN FORESTERS
Mills Building, Washington 6, D. C.

Tom Gill Awarded Medal by Federal Republic of Germany

On January 24, Tom Gill of Washington, D. C., a Fellow of the Society of American Foresters, had conferred upon him by the Federal Republic of Germany the officers' cross of the Republic's order of merit. The presentation was made by the Commercial Counselor of the German Embassy, Dr. Albert F. Ernecke, at a luncheon in his home.

Among those present in honor of the occasion were Henry Clepper of the Society of American Foresters, Fred E. Hornaday of The American Forestry Association, and Wolfgang Koehler, forestry attache of the German Embassy.

Dr. Ernecke paid tribute to Dr. Gill's international travels over a long period of years in behalf of the advancement of world forestry. Dr. Gill was awarded the Sir William Schlich memorial medal by the Society of American Foresters in 1954. Other honors include Mexico's de Quevado Gold Forestry Medal; Chevalier, Mérite Agricole (France); and an honorary degree from the University of the Andes.

Recently retired he had been since 1926 the secretary and the executive director of the Charles Lathrop Pack Forestry Foundation.

PRESENTATION of the Federal Republic of Germany medal of merit to Tom Gill. *L* to *R*: Dr. Albert F. Ernecke, economic counsellor, and Wolfgang Koesler, forestry attaché, of the German Embassy; Mrs. Gill; and Dr. Gill.

Shanklin Cited for Distinguished Service

At the 24th honor awards convocation of the Department of the Interior in Washington, D. C., on January 16, 1961, John F. Shanklin received the Department's highest honor, the Distinguished Service Award, "in recognition of his important contributions to forest management and his eminent career in the Federal service . . ." Mr. Shanklin, staff assistant, forestry, Office of Assistant Secretary—Public Land Management, began his career with the Department in 1933 as a forester with the National Park Service. He was awarded a Merit Citation by the National Civil Service League in 1957.

Federal Department of Forestry Established in Canada

Subsequent to the necessary legislation, there has recently been established in Canada a federal Department of Forestry. Appointed Minister of Forestry is the Honorable Hugh John Flemming, with J. D. B. Harrison deputy minister.

The establishment of the federal department in no way infringes on the constitutional rights of the individual provinces to control and administer the publicly owned forests within their borders as they see fit. This exclusive function of the provincial governments

J. D. B. HARRISON

is in accordance with the terms of the British North America Act. It was pointed out in debate leading up to the establishment of the department that the federal government nevertheless has an inescapable interest in the forest resources of Canada and in the welfare of the forest industries because of the important place that forestry holds in the Canadian economy and particularly in export trade.

The objectives of the new Department of Forestry are to support, through means appropriate to the Dominion Government, improvement in the management and protection of the forest resources, full utilization of products of the forest, and improvement in the competitive position of Canadian forest industries. The department combines the work of the Forestry Branch of the Department of Northern Affairs and National Resources and that of the Forest Biology Division of the Department of Agriculture.

Deputy Minister Harrison, a member of the Society of American Foresters and past president of the (now) Canadian Institute of Forestry, graduated in forestry from the University of New Brunswick in 1924. He served successively in postiions of increasing responsibility in Canadian forestry and was in 1940 named chief of the Economics Division of the Dominion Forest Service. During World War II he served with Timber Control in the Department of Munitions and Supply. He took part in preparatory arrangements for the Forests and Forest Products Division of FAO and was appointed chief of its Economics Section in 1946, serving for 4½ years in Washington, D. C. In 1951 he returned to Canada to become chief of the Forest Research Division of the Forestry Branch, Department of Northern Affairs and National Resources. In 1956 he was appointed Director of the Forestry Branch.

National Watershed Conference

The Eighth National Watershed Congress will be held in Tucson, Ariz., April 17-19, 1961, at the Ramada Inn. Sponsored by more than 20 industrial, agricultural, and conservation organizations, including the Society of American Foresters, the annual meeting affords an over-all review and discussion of watershed programs, problems, and progress. The Congress does not adopt resolutions or promote specific projects but is dedicated to improved natural resource management and use on a watershed basis.

Rao Appointed Inspector General of Indian Forest Service

Shri V. S. Rao has been appointed inspector general of the Indian Forest Service at New Delhi. He is 54 years of age, and joined the Service in 1930, having been educated at Dehra Dun. He succeeded G. G. Takle. Prior to his recent appointment, Mr. Rao had been conservator-general of forests for West Bengal. He is well known in the United States, and attended the Fifth World Forestry Congress last year.

AAAS Holds Its Largest Meeting

The December 26-30, 1960, meeting of the American Association for the

TM MODEL

Lowther Heavy duty tree planters insure deep penetration and straight root systems.

Our Sod Scalpers aid survival and growth.

Six distinctly different models available to cover all soil and terrain conditions.

For details write

HARRY A. LOWTHER COMPANY

1671 DEARBORN STREET
AURORA, ILLINOIS

GRUBBING TONGS

With the Shox—Stox grubbing tongs you can clear brush and trees up to 10" Dia. from banks of streams, pastures and fence lines.

Removes growth cleanly — roots too. Trees can be pulled from any direction. Handles the power of all farm tractors. Tongs cannot slip, the harder you pull the tighter they grip.

No. 63C
Wt. 14 lbs. for Trees up to 6" diameter

Price Delivered $16.50

BARTLETT MFG. CO.

3015 E. Grand Blvd.
Detroit 2, Mich.

Advancement of Science, held in New York City, was reported to be that organization's largest meeting since its inception in 1848. Over 7,000 members and guests registered.

The SAF is represented on the Council of the AAAS by Paul M. Dunn and Carl E. Ostrom. In reporting on the meetings of the Council Mr. Dunn said the 1961 program will emphasize "ways and means of promoting better communication of Science to the Public." The publications phase of the AAAS program will be studied and a proposal to issue a "Bulletin" to all members was approved. Membership approximates 62,000, a portion of whom are laymen.

Public

BLM Director Appointed

Karl S. Landstrom, a native of Lebanon, Ore., and a long-time career conservationist, was appointed director of the Bureau of Land Management, effective February 1, Secretary of the Interior Stewart L. Udall has announced.

A career civil servant, Mr. Landstrom has had nearly 25 years of experience in the field of public land management. He goes to BLM from the staff of the House Committee on Interior and Insular Affairs, and succeeds Edward Woozley of Malad, Idaho.

Mr. Landstrom, 51, was graduated from the University of Oregon (M.A., 1932) and began his career as an economist in flood control and water conservation with the U. S. Department of Agriculture in 1937. He joined the Bureau of Land Management in 1949 as regional chief of Lands and Minerals, Portland, Ore. He also served for several years as alternate member of the Department's Pacific Northwest Field Committee and consultant to the Columbia Basin Interagency Committee.

In 1953, Mr. Landstrom transferred to the Washington, D. C., staff of BLM, where he worked on land classification, program planning, and land appraisals.

Mr. Landstrom received the degree of Juris Doctor from George Washington University, Washington, D. C., in 1959. He is a member of Phi Beta Kappa and several Bar and economic associations.

In July 1960 Mr. Landstrom, a colonel in the U. S. Army Reserve, completed 30 years of commissioned service in the Infantry and Civil Affairs branches of the Army. During World War II he served in the European Theater as Commanding Officer of the 3rd Battalion, 274th Infantry Regiment, 70th Division, and Chief of Food and Agriculture in the U. S. Military Government for Bavaria.

Michigan State Forester Retires, Successor Named

George S. McIntire, chief of the Forestry Division, Michigan Department of Conservation, retired on January 13, 1961. He was succeeded in the post by Theron E. "Ted" Daw.

Mr. McIntire, who joined the former Michigan Land Economic Survey in 1926 following graduation in forestry from Iowa State College, became assistant chief of the Forestry Division of the Conservation Department in 1929. He became Division chief in 1948. During Mr. McIntire's 35 years of state service the Division has grown from a small organization composed of two technical foresters and a dozen full time field men, with one state nursery and 850,000 acres of state land, to one employing nearly 100 full time workers including 65 technically trained foresters. The Division now operates four tree nurseries, administers 3.75 million acres of forest land, and conducts statewide programs in fire control and private forestry cooperation.

BASIC ECONOMY IN SMALL LOGS!
GARRETT
Tree Farmer®
4-wheel drive
4-wheel steering
THINNING
PULPWOOD
PRE-LOGGING
RE-LOGGING
GO
with GARRETT
First tractor designed 100% for tree farming with 4-wheel drive and steering, front axle oscillation. Gives faster skidding, lower operating cost. Reduces road building, site disturbance. Write for specifications and production records.
Garrett-Enumclaw Co., 800-J Stevenson Av., Enumclaw, Wash.

*20 MILLION TREES A YEAR!
*NOW OVER 35 MILLION!
MUSSER TREES MAKE BETTER TIMBER
Because of Selected Seed, Good Heredity, Scientific Methods of planting and propagation, Musser trees grow and thrive where others may fail to survive.
Musser offers a wide range of seedlings and transplants at a price made possible through large quantity production. For example:
SEE THE DIFFERENCE
NORWAY SPRUCE
Fast Growing per 1000
2-yrs., 5 to 10"—$35.00
3-yrs., 10 to 18"—$45.00
*Heavy Roots and Sturdy Tops of Musser Seedlings compared with ordinary seedlings.
Free Catalog
with wholesale planting list and Christmas Tree Growers' Guide.
MUSSER FORESTS, INC.
BOX 26-C
INDIANA, PA.

"Here's the TIME-PROVEN Tree Marking Paint right for Us Foresters !"
SAVANNAH
Tree Marking
PAINT
IT'S A FACT--
Savannah Tree Marking Paint
• OVER 300,000 GALLONS
USED DURING LAST 8 YEARS
• EASY TO USE
• LONG LASTING
• PROMPT SHIPMENT
WRITE for color card, information on price, types of containers, etc.
Savannah Paint Mfg. Co.
SAVANNAH, GEORGIA
P. O. BOX 3162, Dept. A STN. A

Mr. McIntire has been a staunch supporter of the integration of game management and recreation with timber production on state forests. The latter now produce some $3/4 million annually in stumpage sales. He has stressed cooperation with other agencies and divisions of state government in a coordinated approach to wild land management. Under the state's expanded nursery operations, over 30 million trees are grown annually and Michigan has become a national leader in reforestation with more than a million acres of private and public planting. The state's first forest campground was established by McIntire in 1928 and he has developed the system into the present 100 camping areas that currently provide nearly a half million days of recreational use annually.

Mr. Daw, who succeeds McIntire, is a veteran of 31 years with the Department and was assistant chief of the Forestry Division at the time of his appointment.

Daw joined the Department in 1929 as a forest mapper in the old Economic Survey Division, shortly after graduating from Michigan State University with a B. S. degree in forestry. He became chief forester of the Division in the following year and from 1933 to 1934 served as camp supervisor in the Civilian Conservation Corps. In 1934, he was named forest fire survey engineer in the Field Administration Division. Daw joined the Forestry Division in 1945 and for four years was in charge of the cooperative forest management program. He became assistant chief of the Division in 1949.

GEORGE S. MCINTIRE

Conrad L. Wirth To Remain As Director of the National Park Service

Secretary of the Interior Stewart L. Udall announced in January that Conrad L. Wirth will continue as director of the National Park Service.

Mr. Wirth's first government job was with the National Capital Park and Planning Commission (now the National Capital Planning Commission) in 1928. In 1931, Horace M. Albright—then director of the National Park Service—requested his transfer to the Service as assistant director in charge of land planning.

He became associate director of the Park Service in April 1951 and director in December 1951.

Wirth has been the recipient of many honor degrees and awards, including the National Civil Service League's Career Service Award for 1959; the Horace Marden Albright Scenic Preservation Medal for 1958; an Honorary Degree of Doctor of Landscape Architecture from his Alma Mater, the University of Massachusetts, in 1935; and the Pugsley Gold Medal in 1946 for long and valuable service in behalf of the National Parks. Director Wirth is also a life member of the Board of Trustees of the National Geographic Society.

Heaton Named to Region Post

Phillip L. Heaton from U. S. Forest Service headquarters in Washington, D. C., will become assistant regional forester and chief of the Division of Recreation for Region 6 (Oregon and Washington) on April 30, 1961.

Regional Forester J. Herbert Stone, Portland, said Heaton will succeed Frank B. Folsom, who retired in January after 38 years service.

Heaton goes to his new post from that of director of the National Forest Recreation Survey, a two-year study of outdoor recreation resources of all national forest lands. The program, launched in 1959, will evaluate national forest recreation resources.

Heaton was assigned to the office in Washington two years ago from the Region 2 office at Denver, where he was in charge of recreation and land uses.

During his Forst Service career, Heaton has served on national forests in South Dakota, Nebraska, Colorado, and Wyoming, including four years as supervisor of the Bighorn National Forest in Wyoming. From January 1947 to March 1949, he was forestry

EVERGREEN
SEEDLINGS AND TRANSPLANTS
Growers of Pine, Spruce, Fir, Hemlock, etc.
FREE WHOLESALE PRICE LIST
SUNCREST NURSERIES
BOX 305-G, HOMER CITY, PENNA.

THE FECHHEIMER BROS. CO.
UNIFORMS FOR OVER 80 YEARS
U. S. FOREST SERVICE—STATE AGENCIES
MISC. OUTDOOR EMPLOYEES
Complete Price List on Request
CINCINNATI 2, OHIO

FOREST SEEDS of CALIFORNIA
R. S. Adams & A. P. Baal
Professional Foresters
P.O. Box 561 — Davis, California
since 1952

PLANTING TREES ?
Use a "FORESTER" or "CONSERVATOR" Planter
Complete information on request
UT&BCo
UTILITY TOOL & BODY CO.
Clintonville, Wis.

BAKED ENAMEL
METAL FORESTRY SIGNS
for WOODLAND BOUNDARY MARKERS—NO TRESPASSING & FIRE WARNING SIGNS—LOCATION MARKERS—CRUISER TAGS—etc., any size to your specifications. WRITE FOR QUOTATIONS ON ALL YOUR SIGN NEEDS. State size and quantity.
A. L. LIND COMPANY
5006 THOMAS AVENUE SOUTH
MINNEAPOLIS 10, MINNESOTA

THE BEST EVERGREENS COME FROM WESTERN MAINE
American Arborvitae, Balsam Fir, Colorado Blue Spruce, Douglas Fir, Scotch Pine, Norway Spruce, White Spruce, etc. Free Folder lists complete selection of guaranteed to live evergreens at reasonable prices. Write today.
WESTERN MAINE FOREST NURSERY CO.
Dept. JF21
Fryeburg, Maine

SILVA COMPASS
Easy, Precise, Fast to Use!
Recommended by foresters. Built-in mechanism to adjust for declination; sighting mirror; many other features. Write for free literature and instructions.
SILVA, INC. La Porte, Ind.
RANGER MODEL

FREE CATALOG of Forestry Supplies
Ask for Catalog No. 6—80 pages illustrating hundreds of items for Forestry . . . Wildlife Management and Soil Conservation. Buy from one source . . . at moneysaving prices. Prompt shipment.
NASCO, Inc.
Fort Atkinson, Wisconsin

Consulting Foresters

Professional Services Offered by
Members of the Society of American Foresters

KEITH CRANSTON, FORESTRY CONSULTANT
LELAND, MISSISSIPPI (HEADQUARTERS)
Professional services and nationwide loans.
Supervision of estates; Management; Marketing; Appraisals; Forestry Personnel Placement with Industry.

FOREST MANAGEMENT
Topographic Mapping — Forest Development Studies
Timber Stand Maps — Forest Inventories
Land Classification — Forest Appraisals
Hammon, Jensen & Wallen
MAPPING AND FORESTRY SERVICES
660 HEGENBERGER ROAD — OAKLAND 21, CALIFORNIA
General Photogrammetric and Forestry Consulting Services

Land Surveyors — *Consulting Forest Engineers*
BELANGER and BOURGET
86 MOUNTAIN HILL, QUEBEC,
P.Q., CANADA
Forest Surveys and Inventories. Establishing of boundary lines.
Forest Management and Logging plans. Locations for Wood industries.

DOMESTIC — TROPICAL
LICENSED TIMBERLAND BROKERAGE
GREENACRES, INC.
FOREST CONSULTANTS USING ENGINEERS—APPRAISERS
FOREST INVENTORIES—DATA PROCESSING
4501 RAINIER AVE.
SEATTLE 8, WASH.
PArkway 5-7800
M. P. LAZARA
General Manager
PERRY O. DONALDSON
KENNETH E. BEIL
ALAN C. RANDALL
CLINTON W. MORROW

POMEROY & McGOWIN
FOREST MANAGERS
Monticello, Arkansas — Chapman, Alabama

adviser to the Military Government in Korea. He is a 1936 graduate of Colorado State University.

Zasada to Washington Post

Zigmond A. Zasada, leader at the Grand Rapids, Minn., field unit of the Lake States Forest Experiment Station, has been promoted and transferred to the Washington, D. C., office of the U. S. Forest Service. The transfer was effective in January.

In his new position as staff assistant in Research Administration, Mr. Zasada will be primarily concerned with the operational phases of research such as cooperative research agreements, special studies of budgetary and allotment problems, special reports for Congress, and participation

ZIGMOND A. ZASADA

in staff work for the National Forest Research Advisory Committee.

A native of New York, Mr. Zasada was graduated from the New York State College of Forestry in 1931. After two years of private employment in logging and cruising work, he was appointed as a technical foreman on the Chippewa National Forest in Minnesota. He was appointed to the Lake States Station in 1945.

Loan Program to Aid Small Business Firms Buying Timber

A new program to provide loans to small firms purchasing timber from national forests has been announced by the Small Business Administration and the U. S. Department of Agriculture.

The program, developed jointly by the Small Business Administration and the U. S. Forest Service, will provide small firms with funds for building access roads and thus reduce the strain on working capital needed for normal operating expenses.

Applications to SBA for road construction loans will be accepted only from small business concerns who are successful bidders for national forest timber sales and who can meet the size, eligibility, and credit requirements of the Small Business Administration.

SBA business loans may not exceed $350,000 in Government funds to a borrower, but loans of this type will also be limited to the amount of the Forest Service's estimate of the cost of construction of the access road.

Outlook for Naval Stores to Be Studied

A comprehensive study of potential future supplies and demands for rosin, turpentine, and other naval stores products has been started, according to the Department of Agriculture.

"This cooperative study, which involves several USDA agencies, was prompted by recent substantial increases in demands for and prices of rosin, and recurring questions as to the future of the naval stores industry," V. L. Harper, assistant chief for research of the U. S. Forest Service, stated.

Department agencies participating in the study include the Agricultural Conservation Program Service, Agricultural Marketing Service, Agricultural Research Service, Commodity Stabilization Service, and the Forest Service.

National Forest Wilderness and Recreation Developments Expanded in 1960

Development of additional family units for camping and picnicking, expansion of the recreation research program, and additions to the wilderness system marked progress made in improving national forest recreation facilities during 1960.

"Recreation visits to the National Forests have been increasing by more than 12 percent a year," Richard E. McArdle, chief of the Forest Service, said. "This year more than 90 million recreation visits have already been reported. New facilities to relieve the overcrowding which exists at many camp and picnic sites is still a pressing need."

Research programs have been set up to find a more efficient system of gathering recreation statistics; to determine effects of concentrated use on different types of vegetation and soils as a guide for the carrying capacities of recreation sites; and to establish guides for planning, developing, and managing areas of concentrated use.

As a base for locating future recreation areas, a survey of recreational opportunities in the national forests was completed.

At least 1,000 new camp and picnic units for families were constructed in 1960 under Operation Outdoors. Additional trailside shelters were built for hikers and new trails for horseback riders. New ski runs were developed by private capital on national forest lands under paid permit.

Half a million acres were added to the national forest wilderness system. Largest addition was the 458,505-acre Glacier Peak Wilderness in the Washington Cascades. Also new was the 6,051-acre Wheeler Peak Wild Area in New Mexico.

Private & Industrial

Industry Reports Extensive Recreation Uses

More than 50 million acres of commercial timberlands owned by lumber, pulp, paper, plywood and other wood-processing companies are open for public recreation in one form or another.

American Forest Products Industries in 1960 surveyed 518 companies owning 86.2 percent of forest industry commercial timberland, and found vast areas open to the public for hunting, fishing, camping, picnicking, hiking, skiing, and other outdoor sports.

The survey covered 58,140,936 acres as compared to 46,263,852 acres surveyed in a 1956 study.

The new survey revealed that 53,654,702 acres—92.3 percent of the acreage surveyed—are open to hunting in season.

Fishermen can enjoy their sport on nearly 40,000 miles of streams on lands of companies owning 56,646,326 acres, 97.4 percent of the area surveyed.

Companies covered by the survey reported that annual recreation visits to their lands total 6,057,660.

"The new survey," said James C.

WILLIAM A. EASTMAN, JR.
Consulting Forester
Complete Professional Service
SEATTLE 1, WASHINGTON
410 J. GREEN BUILDING
'Phone MAin 4-2814

Consulting Forester — Forest Surveyor
JOHN STOCK
Specializing in Adirondack Forest and Tax Problems
Box 311 — Tupper Lake, N. Y.

ALBERT G. HALL
Forestry Relations Counsel
Consulting Forester
Member, Association of Consulting Foresters
810 18th St., N.W., Washington 6, D.C.

TREE FARM MANAGEMENT SERVICE
1166-7th Avenue, West, Eugene, Oregon
Protection—Reforestation—Inventory
Utilization—Research
Verne D. Bronson, Chief forester, Phone 5-5871

COST ESTIMATES—TAX APPRAISALS—CRUISING SURVEYS AND MANAGEMENT
INTERMOUNTAIN TIMBER SERVICE
4101 STATE ST.
PHONE 2-4300
THOMAS (TOM) C. CLIFTON

JACK E. WINN
Forest Land Evaluation
Tree Farm Management
OLYMPIA, WASHINGTON
2544 SO. QUINCE — FLeetwood 2-0465

WILLIAM H. PRICE
FOREST MANAGEMENT
Specializing in
Timber Tax Problems
2626 W. Lynn—Seattle 99, Wash.
AT 3-7482

Stevens Forestry Service, Inc.
Timber Estimates • Timber Marking • Timberland Management
If it's Trees or Timber, it's our Business
P. O. Box 1070 — Phone 3-5068
EL DORADO, ARKANSAS

SOIL SCIENTISTS — FORESTERS
T. S. Coile, Inc.
Forest Land Consultants
ROUTE 2, BOX 376, DURHAM, N. C. — *Phones: 8-9240; 4902*
Land Appraisal — Timber Inventories — Soil-Site Surveys
Forest Management Planning — Growth Prediction — Research
"Forest Management Based on Soil Productivity"

FOREST PROPERTY
Estimates—Appraisals—Management
Prentiss & Carlisle Co., Inc.
107 Court Street Bangor, Maine

WESTERN TIMBER SERVICES
California-Oregon-Washington
Robert E. Kleiner
Arcata, California
Arcata Hotel Bldg. — VA-2-1333

EDWARD F. STEIGERWALDT
Consulting Forester
Tomahawk Wisconsin

JOHN G. GUTHRIE
Consulting Forester
BOX 517 WIGGINS, MISS.
PHONE WALNUT 8-4958

PAUL T. WINSLOW
Consulting Forest Engineer
ESTIMATES—APPRAISALS—MANAGEMENT
STAATSBURGH-ON-HUDSON, N. Y.

JACK M. HALL
Consulting Forester
Appraisals - Selective Marking
Machine Tree Planting Service
MOULTRIE, GEORGIA

FRANK J. LEMIEUX
Forester
1015 WHITNEY BUILDING
NEW ORLEANS, LA.

McClellan, AFPI chief forester, "shows that these companies are not only growing wood required for useful products, but they also are making a major contribution to the recreation needs of our growing population."

The term "open" as used in tabulating results of the survey applies to the general public in most instances, said McClellan, yet it also applies to lands that are open only to community groups, sportsmen's clubs and others granted privileges by permit only. In some cases, company timberlands are available only for community use.

The survey showed that 107 companies operate 303 public parks and picnic areas, some of them elaborately equipped with free overnight facilities and services.

Forty-three companies plan additional parks in 1961, while 93 companies plan to develop parks after 1961.

Facilities provided at parks and picnic areas include tables and benches, firewood, fishing, overnight camping, swimming, parking areas, boating and boat ramps, toilets, garbage pits, running water, stoves and other equipment.

Seven companies, the survey showed, employ professional recreational planners.

Bowater Forester Promoted

W. Lester Brown, Catawba, S. C., has been promoted to land management forester for the Catawba Timber Company. Announcement of his promotion was made by H. C. Carruth, vice president of the company. This organization furnishes wood for the Bowater plants at Catawba, S. C.

Mr. Brown joined the Bowater organization in January, 1955 as a forester at Hiwassee Land Company. He joined Catawba Timber Company in June 1957, as land acquisition forester.

A native of Heflin, Alabama, Brown graduated from Auburn University with a B. S. in forestry. He is a

W. LESTER BROWN

Navy veteran of World War II and served in the Pacific Theater of operations.

Before joining Bowater, Brown was associated with Gulf States Creosoting Company for six years.

Receives Isaak Walton League Award

Albert Wiesendanger, executive secretary of the Keep Oregon Green Association, has been honored by receipt of a golden Beaver Award from the Oregon Division of the Isaak Walton League. The award presented by P. W. Schneider, director, Oregon State Game Commission, was made at a special luncheon on November 26, 1960, during the 38th annual convention of the Oregon League Division at Salem.

Mr. Wiesendanger joined the Keep Oregon Green Association in 1948, following more than 30 years with the U. S. Forest Service. He was cited for his achievements in conservation with emphasis on his year-round forest fire prevention program to reduce man-caused forest and range fires.

Angle Heads Texas Group

Marvin Angle, area superintendent, International Paper Co., Nacogdoches, was elected president of the Texas Forestry Association at a special meeting of the board of directors attending the 46th annual meeting of the Association.

Other officers elected were Stephen Chase, Jr., The Champion Paper and Fibre Co., Pasadena, first vice president, and Steve C. Kardell, San Augustine, second vice president. E. R. Wagoner, Lufkin, was reappointed executive secretary. E. O. Siecke, College Stations, is past president.

GEORGE BANZHAF & COMPANY
422 North Water Street MILWAUKEE 2 BRoadway 6-2062
Consultants to the Wood Using Industries

50th YEAR—TIMBERLAND MANAGEMENT, INVENTORY, APPRAISAL AND MULTIPLE LAND USE PROGRAMS
James W. Sewall Company Old Town, Maine
Branches— Fredericton, New Brunswick, Canada
Cordova, Alaska

HONORARY INITIATES. Eleven students and faculty members of the Department of Forestry, Auburn University School of Agriculture, were recently initiated into the Sigma Chapter of Xi Sigma Pi, national forestry honorary. New members from left to right are: Dr. Mason Carter, assistant forester, Donald H. J. Steensen, assistant professor of forestry, Joseph Dinkins, Handley Fincher, Philip Hodgkins, Edward Givhan, Walt Sellers, Jerry Williams, and Terry Sellers.

Schools

Amidon Named Greeley Lecturer

The appointment of George B. Amidon of International Falls, Minn., as the 1961 Colonel William B. Greeley Lecturer in Industrial Forestry has been announced by Dean Gordon D. Marckworth of the University of Washington College of Forestry, Seattle. Mr. Amidon will present a series of three lectures on the "Development of Industrial Forestry in the Lake States" on March 2, 3 and 4, 1961.

Mr. Amidon's lectures will be the fifth in the series on industrial forestry made possible through a grant from the Industrial Forestry Association as a memorial to the late Colonel William B. Greeley. Amidon is the director of woodlands for the Minnesota and Ontario Paper Company of International Falls, a position he has held since 1944.

Previous speakers in the industrial forestry lecture series included Axel J. F. Brandstrom, Frank Heyward, Clarence S. Herr, and Emanuel Fritz.

Clemson College Appoints Three Additional Foresters

Three additional appointments have been made to the teaching and research staff of the Forestry Department of Clemson College. They are: Carl Leaton Lane, Wm. H. Davis McGregor, and William C. Randel.

Lane, recently appointed assistant professor of forestry, received his B.S. degree in forestry from the North Carolina State College in 1952 and his Master degree in forestry in 1960.

Dr. McGregor, associate professor of forestry, received his B.S. degree in biological sciences from Clemson College in 1951. He then attended the University of Michigan where he received his B.S. and Master in 1953.

In 1955-1957 he pursued graduate studies in forest tree physiology at Duke University where he was granted his Ph.D. in 1958.

Randel, associate professor of forestry, received his B.S. in forestry from Purdue in 1939, and his M.F. from the New York State College of Forestry in 1940.

Professor Randel was a member of the faculty of Michigan State University from 1948 to 1958. During this period he completed two semesters' work on his Ph. D. at the University of Michigan, Ann Arbor. He returned to the New York State College of Forestry in 1958 where he completed his residence toward his Ph.D.

The Clemson College Department of Forestry, of which Dr. Koloman Lehotsky is head, has eleven members on its teaching and research staff. It was established July 1, 1957 and has offered a professional course in forestry since then.

Student Research Grants by National Science Foundation

Undergraduates will work alongside scientists of more than 250 colleges and universities beginning next summer as a result of National Science Foundation grants.

The students will have the opportunity to engage in scientific research either as an individual working under the direct supervision of an established scientist, or directly with the scientist as a member of a research team.

The Foundation made available $3.2 million in 357 grants through its Undergraduate Research Participation program to help build the interest of superior students in research, to widen their understanding of scientific method, and to improve their ability to employ scientific investigative procedures. The program is now in its third year.

The newly announced grants will allow for about 37 percent of the participants to work in chemistry, 26 per-

RESIDENCE MU 8-4353
OFFICE MU 6-4103
DOUGLAS F. HORAN
Consultant Forester
316 WINDSOR LAKELAND, FLA.

THOMAS F. SCHWEIGERT, R.F., R.L.S.
Consulting Forester
Land Surveyor
Penney Building, Petoskey, Michigan

Ed Knapp Company
G. E. Knapp • D. L. Martindale
Consulting Foresters
4435 Pio Nono Ave. Macon, Georgia

GION B. HOOKER
Consulting Forester
1072 ANZIO ST.
CRESCENT CITY, CALIFORNIA

ADIRONDACK FORESTRY, INC.
David E. Strong Donald E. Peterson
Consultants
Estimates, Appraisals, Marketing
Management Plans, Tree Planting, Preservation
WILMINGTON, NEW YORK

MILLIKEN FORESTRY COMPANY
CONSULTANTS—APPRAISERS—MANAGERS
500 BELT LINE BLVD. P.O. BOX 8404
COLUMBIA, S. C.
WILLIAM F. MILLIKEN

K. M. ALLAN
JAMES R. CATHCART, JR.
HUGH M. LUPOLD

Index to Advertisers

Adirondack Forestry, Inc. 243
Banzhaf, George & Company 242
Bartlett Mfg. Company 237
Belanger & Bourget 240
Coile, T. S. Inc. 241
Cranston, Keith 240
Eastman, Wm. A., Jr. 241
Fechheimer Brothers Co. 239
Flickingers' Nursery 230
Forest Seeds of California 239
Forestry Suppliers, Inc. 166
Garrett Enumclaw Co. 238
Greenacres, Inc. 240
Gunthrie, John G. 242
Hall, Albert G. 241
Hall, Jack M. 242
Hammon, Jensen & Wallen 240
Haynes Manufacturing Co. 229
Homelite Corporation ..... 4th Cover
Hooker, Gion B. 243
Horan, Douglas F. 243
Intermountain Timber Service 241
International Harvester Co. 232, 233
Knapp, Ed. Company 243
Lemieux, Frank J. 242
Lind, A. L. Co. 239
Lowther Co., Harry A. 237
McGraw-Hill Book Co., Inc. 227
Meadows, Ben Company 231
Milliken Forestry Co. 243
Mora Chemical Corporation 226
Motorola, Communications 228
Musser Forests, Inc. 238
Natl. Agric. Supply Co. 239
Nelson Company 234
Omark Industries ..... 3rd Cover
Pacific Weather Service 229
Paint Creek Nurseries 230
Panama Pump Company 235
Pomeroy & McGowin 240
Prentiss & Carlisle 242
Price, William H. 241
Reasor-Hill Corp. 236
Rootspread Tree Planters 230
Savannah Paint Co. 238
Schweigert, Thomas F. 243
Sebrell, J. B. Co. 230
Sewall, James W. Co. 242
Silva, Inc. 239
Smith, D. B. & Co. ..... 2nd Cover
Southern Seed Co. 229
Steigerwaldt, Edward F. 242
Stevens Forestry Service 241
Stock, John W. 241
Suncrest Evergreen Nurseries 239
Tree Farm Mgmt. Service 241
Utility Tool & Body Co. 239
Western Fire Eqpt. Co. 236
Western Maine Forest Nursery 239
Western Timber Services 242
Weyerhaeuser Company 225
Winn, Jack E. 241
Winslow, Paul T. 242

cent in the biological sciences, 13 percent in engineering, and 12 percent in physics, with the remainder in astronomy, geology, mathematics, psychology, and the quantitative social sciences.

Only two of the 250 colleges and universities listed have grants for research in forestry. These are the College of Forestry at Syracuse, N. Y., and North Carolina State College at Raleigh.

Short Courses and Conferences

College of Forestry, University of Washington, Seattle, March 13-17, 1961. "Application and Use of Aerial Photographs in Forestry;" March 20-25, 1961, in cooperation with the Institute of Forest Products—"Lumber Seasoning Course and Kiln Drying Demonstration."

Pennsylvania State University, University Park, March 27-31, 1961—annual "Hardwood Lumber Grading Short Course."

North Carolina State College, Raleigh, April 5-6, 1961—"The South Atlantic Wood Pole Conference." A program of basic technology and current information on the production, deterioration, preservative treatment, purchasing, inspection, and maintenance of wood utility poles.

School of Forestry, Louisiana State University, Baton Rouge, April 6-7, 1961—"The Tenth Annual Forestry Symposium," Subject: "Advances in Management of Southern Pines."

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

Positions Wanted

B.S.F., U. of Maine, 1956, seeks responsible position with company engaged in logging or pulpwood operations anywhere in U. S. 6 months State Forester; 3½ years active duty U. S. Army officer. Presently Assistant Superintendent large pulpwood operation Eastern Canada. Fluent French-German. Age 28, married, 3 children.
Box U, Society of American Foresters, 425 Mills Bldg., Washington 6, D. C.

Forester, logger, businessman, B.F. 1940, Oregon State. Two years logging camp, nine years Forest Land Manager (large tree farm). Three years logging manager ($2.7 to 3 million annual business). Managed all phases tree farming and logging. Know Douglas fir and Ponderosa pine operations first hand. Will consider employment, contracting, or ownership in western operation or property.
Box V, Society of American Foresters, 425 Mills Bldg., Washington 6, D. C.

Forester, B.S., June 1961, University of Mass. Age 27, married, two children. Desires to begin career in forest management with state, or private industry. Prefer Northeast, but will consider any location.
Box W, Society of American Foresters, 425 Mills Bldg., Washington 6, D. C.

Forester, B.S.F., Michigan. Desires position anywhere in U. S. with opportunities for advancement. Experience in private industry and Soil Conservation Service.
Box X, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

Forester, B.S.F., Purdue University, 1949. Age 40, veteran, married, two children. Experience: four years with Firestone Plantations Company, three years state forestry in timber management and watershed control, presently city forester in small city. Prefer public relations overseas or Southern U. S.
Box Y, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

Forester-photogrammetrist, B.S.F., N.Y. State College of Forestry 1957, advanced studies in photogrammetry, Syracuse University. Age 29, married. Experience: Marine veteran, licensed commercial navigator. Varied forest engineering and photogrammetric engineering from 1950. Presently in industry—military photogrammetric research and studies. Desire forest engineering, forest management field work preferably in New York or New England or apprentice to Consultant Forester or consulting firm.
Box Z, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

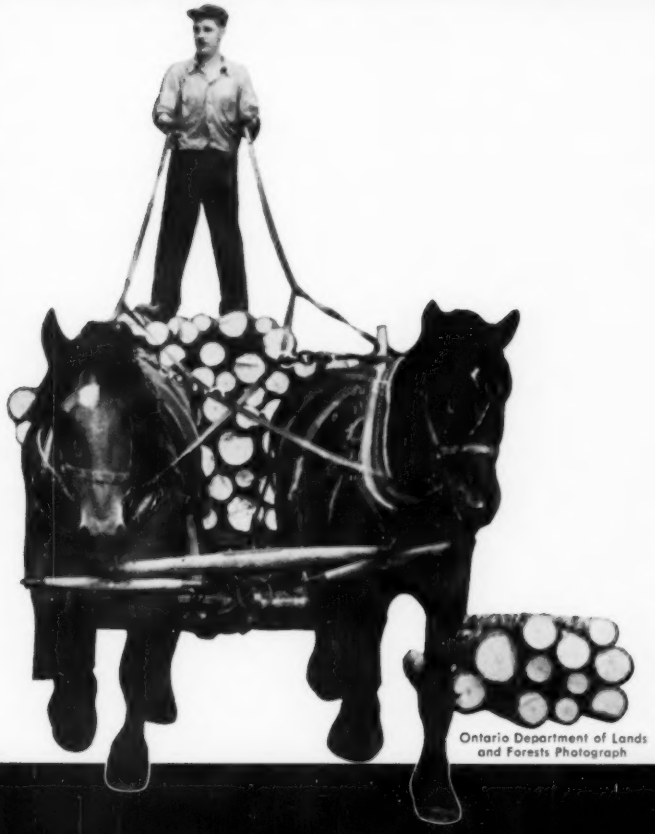
Forester, B.S.F., 1941. Age 46, family. One year graduate work, U. of Mich. Experience: private industry, land & timber management, land acquisition, timber sales, appraisals, road construction, cultural operations, fire control, insect survey—control; nine years supervisory, training younger men; rated pilot. Position in South or Southeast preferred, teaching forestry or in Pulpwood Industry.
Box A, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

Forester, B.S.F., 1955, Michigan State, forest management. Age 28, married, two children. Three years experience U.S. F.S. Oregon; sale layout, appraisal, sale administration, timber stand improvement, road location and design. Supervised large annual reforestation projects. Forest fire control. Reserve active duty completed January, 1961. Desire position with private industry or consulting firm Lake States, Pacific Northwest, or Northeast.
Box B, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

Forester, B.S. Age 33, married. Experience: Eight years with West Coast industry in forest management, contract logging management on private land and federal timber sales; thinning for saw logs. Currently resident forester of large tree farm. Desire relocation in the West.
Box C, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

Forester, B.S., University of Idaho 1950. Age 35. Veteran, married, two children. Experience: One year State Forestry; three years Asst. Supt. Planer Mill; six years timber appraisal forester for lumber company. Capable of taking charge of timber acquisition program of lumber or pulp company; also consider sales. Prefer Pacific Northwest.
Box D, Society of American Foresters, 425 Mills Building, Washington 6, D. C.

Forester, B.S.F., Michigan College of Mining & Technology, 1955. Age 27, married, two children, veteran. Experience: three years public forestry, timber sales, TSI, supervision of planting, preparing management plans. Desire position with private industry in Lake States or Northeast.
Box E, Society of American Foresters, 425 Mills Building, Washington 6, D. C.



Ontario Department of Lands and Forests Photograph

Go into the hardwood and softwood forests in the North, South and East... into the big trees in the West. You'll see scores of methods of bringing in logs, pulpwood, firewood... dozens of different makes of power saws "cutting 'em down and cutting 'em up."

On the majority of these saws you'll also see the one cutting chain which has become standard for the industry... OREGON Chipper Chain. In fact, since chain saws came into general use a dozen years ago, seven-out-of-ten* owners have chosen OREGON Chain for multi-purpose cutting, in all species of timber, in all ranges of climate.

OREGON Chain maintains its position as the choice of most saw owners... when they buy new saws, when they replace used chain... because time and experience have shown that nothing in the woods matches it for fast, steady, long-lived production.

The next time you buy a chain, join the seven-out-of-ten who choose OREGON. The best dealers everywhere have it.

*Data from 1959 survey, "The Woodcutting Industry." Details on request.

No Matter How They Choose To Bring 'Em In,

7-Out-Of-10 Choose OREGON® Chain To Cut 'Em...

Keep Your Chain Saw OREGON®-IZED!

© Copyright 1961

MICRO-MANUFACTURE Product of

OMARK Industries, Inc. - OREGON Saw Chain Div.

PORTLAND, OREGON • CINCINNATI, OHIO • GUELPH, ONTARIO, CANADA
ADELAIDE, AUSTRALIA • KOPPARBERG, SWEDEN

U. S. Forest Service Photograph

another user testimonial

"The more I run it, the better I like it"

NEW HOMELITE 900 D

Mr. H. G. Hill, lumberjack in Lexington, North Carolina, writes this about his Homelite chain saw: *"I have cut 20,000 feet of timber with my Homelite. The more I run it, the better I like it."*

The new Homelite 900D direct drive chain saw is an outstanding example of this kind of big tree power and stamina. It combines the light weight of 23 pounds (less bar and chain) with a chain speed of 3,000 feet per minute to fell trees up to 7 feet in diameter.

With all this power and easy handling, you get quality product features that keep costs down, keep your Homelite 900D always on the job. New under-shroud design keeps air filter free from debris, improves cooling. Quickly detachable engine shroud permits easy servicing. Long flange guide plates feed chain smoothly into bar groove, eliminate chatter, prolong chain and bar life. New fuel cap relief valve gives positive venting at all times.

Let a free demonstration show you why the Homelite 900D is a top performer in the famous quality Homelite line of eight models. Try it at your nearby Homelite dealer's — the more you run it, the better you will like it.

As little as $5.60 weekly after small down payment

• direct drive • 23 pounds (less bar and chain) • fells trees up to 7 feet in diameter • straight blades from 17″ to 42″; 16″ plunge cut bow.

NEW! Homelite chain and Homelite guide bars make your cutting even more profitable!

Find Your Homelite Dealer In The 'Yellow Pages'

HOMELITE • A DIVISION OF TEXTRON INC.

4103 RIVERDALE AVENUE, PORT CHESTER, NEW YORK In Canada — Terry Machinery Co., Ltd.